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		Env. NA							
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RELEASE AUTHORIZATION

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Release Date:	9/12/94

* * * * * * * * * * * * *

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* * * * * * * * * * * * *

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Organization/Charge Code 7E720/N4D2F

7. Abstract

This document provides the characterization information and interprets the data for Double-Shell Tank AP-105

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Tank Characterization Report for Double-Shell Tank 241-AP-105

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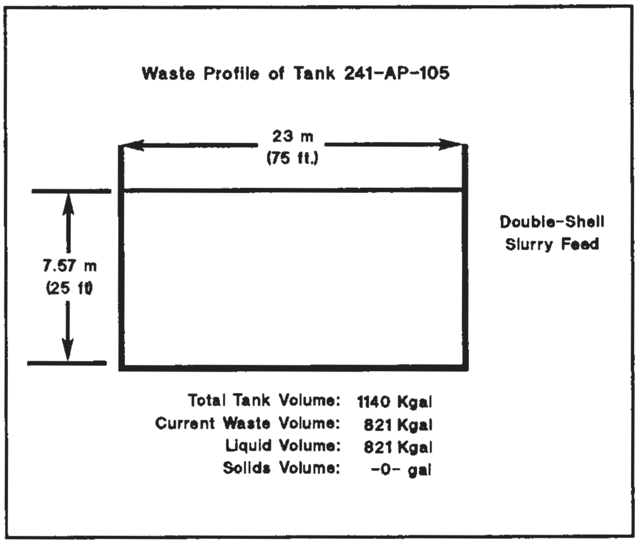
EXECUTIVE SUMMARY

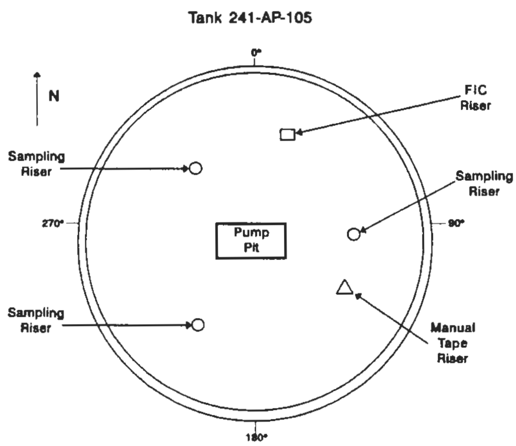
Double-Shell Tank 241-AP-105 is a radioactive waste tank most recently sampled in March of 1993. Sampling and characterization of the waste in Tank 241-AP-105 contributes toward the fulfillment of Milestone M-44-05 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology, EPA, and DOE, 1993). Characterization is also needed to evaluate the waste's fitness for safe processing through an evaporator as part of an overall waste volume reduction program.



Tank 241-AP-105, located in the 200 East Area AP Tank Farm, was constructed and went into service in 1986 as a dilute waste receiver tank; Tank 241-AP-105 was considered as a candidate tank for the Grout Treatment Facility. With the cancellation of the Grout Program, the final disposal of the waste in will be as high- and low-level glass fractions. The tank has an operational capacity of 1,140,000 gallons, and currently contains 821,000 gallons of double-shell slurry feed. The waste is heterogeneous, although distinct layers do not exist. Waste has been removed periodically for processing and concentration through the 242-A Evaporator. The tank is not classified as a Watch List tank and is considered to be sound. There are no Unreviewed Safety Questions associated with Tank 241-AP-105 at this time.

The waste in Tank 241-AP-105 exists as an aqueous solution of metallic salts and radionuclides, with limited amounts of organic complexants. The most prevalent soluble analytes include aluminum, potassium, sodium, hydroxide, carbonate, nitrate, and nitrite. The calculated pH is greater than the *Resource Conservation and Recovery Act* established limit of 12.5 for corrosivity. In addition, cadmium, chromium, and lead concentrations were found at levels greater than their regulatory thresholds. The major radionuclide constituent is ^{137}Cs, while the few organic complexants present include glycolate and oxalate. Approximately 60% of the waste by weight is water. Comparisons to established limits of concern for selected analytes can be made by referring to the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

The results of the analyses have been compared to the dangerous waste codes in the *Washington Dangerous Waste Regulations* (WAC 173-303). This assessment was conducted by comparing tank analyses against dangerous waste characteristics ("D" waste codes) and against state waste codes. It did not include checking tank analyses against "U", "P", "F", or "K" waste codes since application of these codes is dependent on the source of the waste and not on particular constituent concentrations. The results indicate that the waste in this tank is adequately described in the Dangerous Waste Permit Application for the Double-Shell Tank System; this permit is discussed in the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).



TANK 241-AP-105	
Tank Description	
Type:	Double-Shell
Constructed:	1986
In-Service:	1986
Diameter:	75 feet
Usable Depth:	35 feet
Operating Capacity:	1,140,000 gallons (4,320,000 L)
Bottom Shape:	Flat
Hanford Coordinates:	40.393° North 47.100° West
Ventilation:	Operating Exhauster
Tank Status as of June 1994	
Contents:	Double-Shell Slurry Feed
Total Waste:	821,000 gallons (3,110,000 L)
Supernate Volume:	821,000 gallons (3,110,000 L)
Manual Tape Surface Level:	297.25 inches (05/02/94)
FIC Surface Level:	298.00 inches (05/02/94)
Temperature:	71°F (05/02/94)
Integrity Category:	Sound

Double-Shell Tank 241-AP-105
Concentrations and Inventories for Critical List Analytes
(as of June 1994)

Total Tank Volume	1,140,000 gallons (4,320,000 L)	
Total Waste Volume	821,000 gallons (3,110,000 L) 4,140,000 kg	
Supernatant Volume	821,000 gallons (3,110,000 L) 4,140,000 kg	
Physical Properties		
Specific Gravity	1.333	
H_2O	60.3 wt%	
pH	14.5	
Heat Load	~ 3,470 W	
Chemical Constituents	**Average Concentration**	**Bulk Inventory**
K (Potassium)	2.33 wt%	96,400 kg
Al (Aluminum)	0.880 wt%	36,400 kg
Na (Sodium)	12.5 wt%	519,000 kg
Cl^- (Chloride)	0.177 wt%	7,340 kg
F^- (Fluoride)	0.114 wt%	4,730 kg
OH^- (Hydroxide)	4.06 wt%	168,000 kg
NO_3^- (Nitrate)	12.4 wt%	513,000 kg
NO_2^- (Nitrite)	3.62 wt%	150,000 kg
SO_4^{2-} (Sulfate)	0.182 wt%	7,530 kg
Total Organic Carbon	0.207 wt%	8,550 kg
Total Inorganic Carbon	0.338 wt%	14,000 kg
Radionuclides		
Total Plutonium	< 1.05 μCi/L	< 3.28 Ci
Total Uranium	0.00316 wt%	131 kg
^{134}Cs	522 μCi/L	1,620 Ci
^{137}Cs	227,000 μCi/L	706,000 Ci
Organic Complexants		
Citric Acid	0.0338 wt%	1,400 kg
Glycolate	0.0457 wt%	1,890 kg
Oxalate	0.0391 wt%	1,620 kg

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LIST OF TERMS

AEA	alpha energy analysis
CASS	Computer Automated Surveillance System
CFR	*Code of Federal Regualations*
CVAA	cold vapor atomic absorption
DN	dilute non-complexed
DNFSB	Defense Nuclear Facilities Safety Board
DOE	United States Department of Energy
DQO	Data Quality Objective
EPA	United States Environmental Protection Agency
FIC	Food Instrument Company
GHAA	gaseous hydride atomic absorption
IC	Ion Chromatograph
ICP	Inductively Coupled Plasma Atomic Emission Spectrometry
LSC	Liquid Scintillation Counting
MDL	method detection limit
PNL	Pacific Northwest Laboratory
RPD	relative percent difference
RSD	relative standard deviation
SpG	specific gravity
SVOA	semi-volatile organic analysis
TIC	total inorganic carbon
TOC	total organic carbon
TWRS	Tank Waste Remediation System
VOA	volatile organic analysis
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

In March 1993, Double-Shell Tank 241-AP-105 was sampled to determine the acceptability of the waste for the Hanford Grout Disposal Program. This Tank Characterization Report presents an overview of that tank sampling and analysis effort, and contains observations regarding waste characteristics, expected inventory, and concentration data for the waste contents based on this latest sampling data and information on the history of the tank. Finally, this report makes recommendations and conclusions regarding tank operational safety issues.

1.1 PURPOSE

The purpose of this Tank Characterization Report is to describe and characterize the waste in Double-Shell Tank 241-AP-105 (hereafter Tank 241-AP-105) based on information given from various sources. This report summarizes this available information, and arranges it in a useful format for making management and technical decisions concerning this particular waste tank. In addition, conclusions and recommendations based on safety issues and further characterization needs are given. This report presents a comprehensive overview of the material in Tank 241-AP-105. Specific objectives reached by the sampling and characterization of the waste in Tank 241-AP-105 are:

- Contribute toward the fulfillment of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-44-05 concerning the characterization of Hanford Site high-level radioactive waste tanks (Ecology, EPA and DOE; 1993).

- Complete safety screening of the contents of Tank 241-AP-105 to meet the characterization requirements of the *Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 93-5* (Conway, 1993).

- Provide tank waste characterization to the Tank Waste Remediation System (TWRS) Program Elements in accordance with the *TWRS Tank Waste Analysis Plan* (Bell, 1994).

1.2 SCOPE

This report presents a broad background of historical information that was available prior to the sampling activity. The result of this review is the detailed estimation of the contents of Tank 241-AP-105 based on historical process information and detailed transaction records. Next, the results of the sampling and analysis effort are summarized, and interpreted both qualitatively and quantitatively. The information obtained from historical sources is then compared with the actual waste measurements to arrive at final waste inventory and concentration estimates. Finally, conclusions and recommendations are given based on the current waste inventory and tank status.

1.3 ASSUMPTIONS

The concentration and inventory estimates derived for this report are considered by the authors and by the Westinghouse Hanford Company Characterization Program to be the most accurate, defensible, technically valid, and contemporary data concerning Tank 241-AP-105. This Tank Characterization Report incorporates all available previous sampling, characterization, and transfer data concerning Tank 241-AP-105. In addition, estimates of the current tank contents based on process knowledge and waste transaction records provide important cross-checks and corroboration to the inventory estimates derived from recent analytical data. Based on the statistical determination that the tank waste is heterogeneous without distinct layers, and given that the analytical data is valid and defensible, this report is therefore the definitive characterization of the contents of Tank 241-AP-105.

The term "analytical results" is used in this report to denote sample results from the most recent sampling event, the characterization of Tank 241-AP-105 waste for the Grout Program. Characterization data from these samples are used for the analytical section of this report, Section 5.0. The historical characterization of this tank, Section 2.5, is based on the available "historical results" prior to the 1993 sampling.

Tank 241-AP-105 remains in active service for waste management operations. Although the future contents of the tank will likely change, the characterization of Tank 241-AP-105 is considered accurate and representative of the tank contents as of the date of preparation of this report: August, 1994.

2.0 HISTORICAL TANK INFORMATION

The purpose of this section is to describe Tank 241-AP-105 based on historical tank information, and to use this information to predict the constituents of the tank's waste and their concentrations. This section is divided into five parts. A brief description and historical background of the tank comprise the first part, followed by current tank status, a summary of the process sources that contributed to the tank waste, and an estimation of the contents of Tank 241-AP-105 based on historical information. The final part details surveillance data taken on the tank.

2.1 TANK HISTORY

Tank 241-AP-105 is a tank-in-tank design consisting of a heat-treated (stress-relieved) primary steel liner. The tank has a design capacity for storing 1.16 million gallons of waste; however, safety considerations require an operating capacity of 1.14 million gallons. Instruments access Tank 241-AP-105 through risers and monitor the pressure, temperature, liquid level, sludge level, and other bulk tank characteristics (Bell, 1994). Figure 2-1 presents a detailed diagram of a double-shell tank (Hanlon, 1994).

Tank 241-AP-105 is a 1.14 million gallon, radioactive waste tank containing double-shell slurry feed. More than half of the waste currently held in the tank came from Tanks 241-AW-102 and 241-AW-106, and has been concentrated in the 242-A Evaporator. The remainder was later transferred from Tank 241-AP-106. These transfers are discussed in detail in Section 2-3.

Tank 241-AP-105 is now used as a Concentrated Waste Holding Tank; however, it was constructed and went into service in 1986 as a Dilute Receiver Tank. It is one of eight tanks that comprise the 241-AP Tank Farm located in the southeast corner of the 200 East Area. Figure 2-2 shows the Tank Farm's location.

The waste stored in Tank 241-AP-105 was candidate waste for disposal through the Grout Treatment Facility after anticipated blending with dilute waste (Hendrickson & Welsh, 1992). However, none of the tank waste was sent to the facility before the Grout Program was canceled in 1993. With the program's cancellation, the final disposal of all tank wastes will be as high- and low-level glass fractions from the Hanford Waste Vitrification Plant (HWVP).

2.2 TANK STATUS

Tank 241-AP-105 currently contains 821,000 gallons of double-shell slurry feed (Koreski, 1994). The waste is 60.6% water, the rest being dissolved salts (refer to Section 5.0). According to the *Tank Farm Surveillance and Waste Status Summary Report* for November 1993 (Hanlon, 1994), the waste does not contain any solids. However, one sample location did have a solid phase, noticed upon receipt at Pacific Northwest Laboratory (Refer to Section 4.1). The tank is at 72% of capacity (volume) with 319,000 gallons of available space. Tank 241-AP-105 is still in service, as are all eight tanks in the AP Tank Farm.

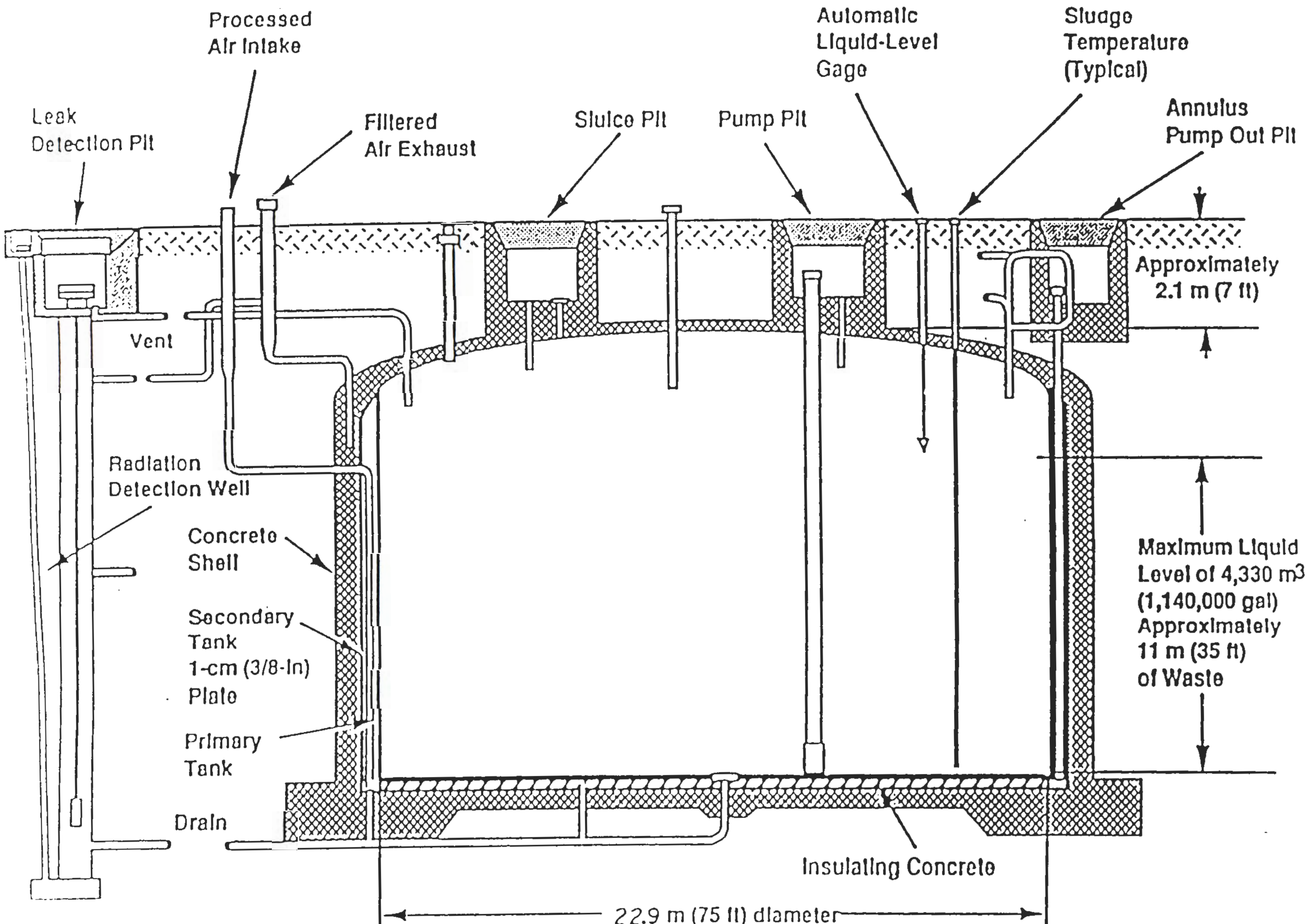
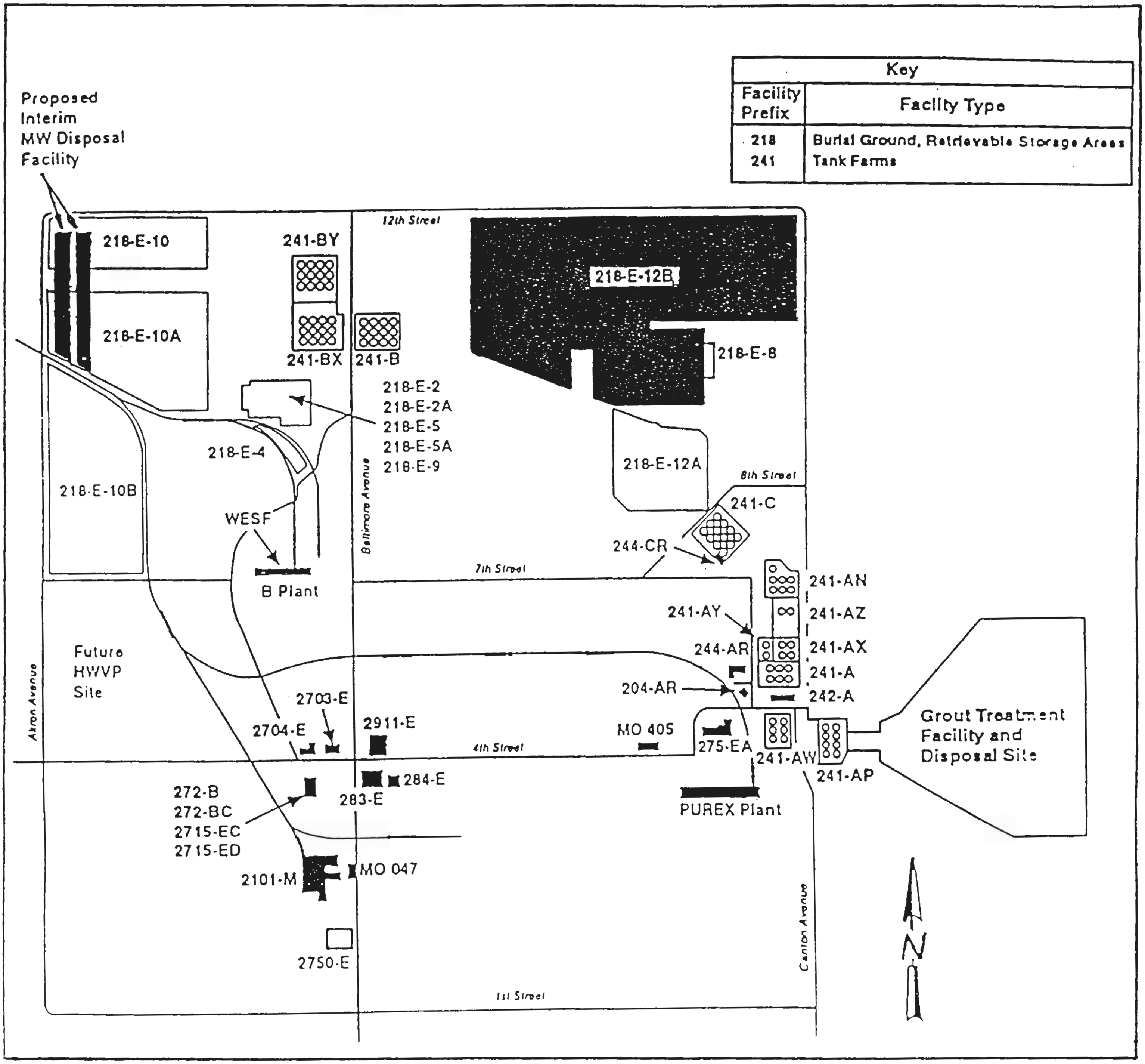


Figure 2-1. Double-Shell Tank Configuration.

Figure 2-2. Location of the 241-AP-Tank Farm.



The "in-service" designation allows these tanks to continue receiving liquid in conjunction with production and/or waste processing operations. The tank integrity is classified as sound and it is not currently on any Watch List. There are no Unreviewed Safety Questions associated with Tank 241-AP-105 at this time.

Tank 241-AP-105 is equipped with both a manual tape and an automated liquid indicator device for surface level readings; both are still operable. The waste occupies approximately 298 inches of the tank. All tank instruments are in monitoring compliance (Hanlon, 1994). The tank's internal temperature was 71°F on May 2, 1994 (Rios, 1994). Active ventilation is used to keep the tank contents cool and to minimize the potential for release of airborne contaminants to the environment (Husa et al., 1993).

Approximately 43% of the current volume of Tank 241-AP-105 is dilute non-complexed waste from Tank 241-AN-106. Before that transfer, Tank 241-AP-105 contained 476,000 gallons of double-shell slurry feed processed in the 242-A Evaporator. This waste came from Tanks 241-AW-102 and 241-AW-106, and flush water.

2.3 PROCESS KNOWLEDGE

Figure 2-3 depicts the fill history of Tank 241-AP-105 for the time period from 1986, when it became operational, to October 1993, the latest entry in the *Waste Volume Projection Historical Database* (Koreski, 1994). A detailed description of the events that contributed to waste being added to or transferred from this tank follows. All information is taken from Koreski (1994) unless otherwise noted.

Tank 241-AP-105 went into service in August 1986 with the addition of 17,000 gallons of flush water. Two smaller additions of water followed in 1987. In January 1988, Tank 241-AP-105 received 91,000 gallons of dilute non-complexed (DN) waste from Tank 241-AW-106, a tank used primarily to hold waste from the 242-A Evaporator. This was followed by the addition of 17,000 gallons of flush water.

Two transfers of DN waste were received in early 1988 from Tank 241-AW-102, the feed tank for the 242-A Evaporator. A transfer of 176,000 gallons in January was followed by another 408,000 gallons in February. After small unknown losses of 1,000 and 2,000 gallons, Tank 241-AP-105 ended the second quarter of 1988 at 62% of capacity with 710,000 gallons of DN waste.

During July, August, and September 1988, most of the contents of the tank (691,000 gallons) were sent to Tank 241-AW-102 for processing in the 242-A Evaporator. In January 1989, 138,000 gallons returned from the evaporator for a reduction volume of approximately 80%. All 157,000 gallons of waste in Tank 241-AP-105 were subsequently transferred to Tank 241-AW-102. The following month, 476,000 gallons of waste were returned to Tank 241-AP-105 from the evaporator.

The final transfer to Tank 241-AP-105 occurred in July 1989, as 355,000 gallons of DN waste were received from Tank 241-AP-106. At the time of the transfer, wastes from the B-Plant and DN feeds comprised most of the waste in Tank 241-AP-106 (Hendrickson and Welsh, 1992). This transfer gave Tank 241-AP-105 its peak volume of 831,000 gallons.

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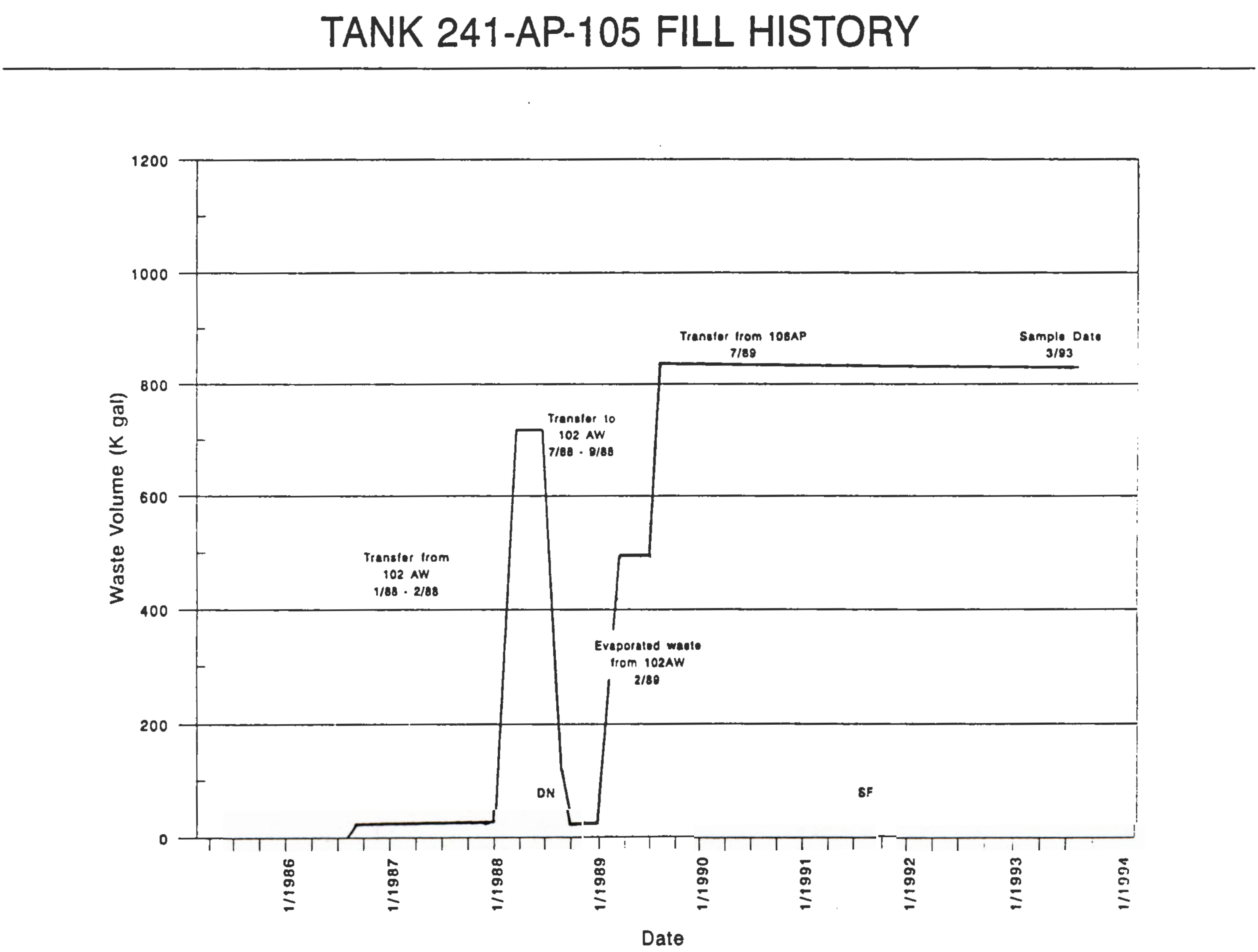
Figure 2-3. Waste Volume History of Tank 241-AP-105.



Since July 1989 several small "unknown" losses and one small "unknown" gain were recorded. Unknown losses are most likely caused by evaporation. Losses or gains due to instrumentation account for changes in tank volume. A switch from one measurement method to another would be recorded as a gain or loss in depth, since the methods do not have the same reference zero. An example of this is changing from the automated liquid level indicator to the manual tape. If the tank volume calculations for Tank 241-AP-105 was changed today from automatic to manual tape, a loss of about 2,000 gallons would result, since the difference between the measured automatic indicator level and the manual tape is 0.75 inches (2,750 gallons per inch). The latest waste volume reported for Tank 241-AP-106 is 821,000 gallons, following the loss of 10,000 gallons over four years. This gradual and constant decline in waste level represents a loss of approximately 7.4 gallons per day, an amount likely attributable to evaporation from the waste's surface.

2.4 HISTORICAL ESTIMATION OF THE CONTENTS OF TANK 241-AP-105

A preliminary estimate of the current waste constituents of Tank 241-AP-105 can be made based on transfer history and analyses of 242-A Evaporator feed and slurry samples. This estimate is useful as a baseline for comparison with the latest tank sampling data, and is presented in Table 2-1 (Hendrickson and Welsh, 1992). The "Estimated Concentration of Tank 241-AP-105" column is obtained by taking an average of the upper and lower half "Estimated Concentration" columns. When only one value appears for a constituent, that value is taken as the estimated tank concentration. For ^{237}Np, a detected value and a detection limit were reported. Since the detection limit was substantially greater, this value provides a "worse-case" estimate and is used as the estimated tank concentration. For ^{241}Am, a detected value provided the "worse-case" and, therefore the nondetected value was not averaged. The "Estimated Concentration of Tank 241-AP-105" column numbers appear as the Historic Tank Content Estimate in Table 5-2. All historical values were taken from Hendrickson and Welsh (1992); the methodology for determining these constituent values is contained in Appendix A of that report.

2.5 SURVEILLANCE DATA

2.5.1 Surface Level Readings

Tank 241-AP-105 is equipped with a liquid-level gauge manufactured by the Food Instrument Corporation (FIC) which can be monitored either automatically or manually. The FIC indicator uses a conductivity probe to detect the waste surface level and, in the automatic mode, is electrically connected to a computer for data transmission via the Computer Automated Surveillance System (CASS). Tank 241-AP-105 is also equipped with a manual tape from which readings are taken when the FIC indicator is out of service. Both devices are currently operable. The most recent FIC liquid level measurement available was 298.0 inches on May 2, 1994 (Rios, 1994). The manual tape reading for the same date was 297.25 inches.

Table 2-1. Estimated Waste Composition of Tank 241-AP-105. (2 pages)

Constituent	Estimated Concentration (upper half of tank)	Estimated Concentration (lower half of tank)	Estimated Concentration of Tank 241-AP-105
Metals	μg/L	μg/L	μg/L
Al	7.70 E+06	1.92 E+06	4.81 E+06
B		2.14 E+04	2.14 E+04
Ca		6.66 E+04	6.66 E+04
Cr		2.67 E+05	2.67 E+05
Fe		9.67 E+03	9.67 E+03
Mg		9.09 E+03	9.09 E+03
P		4.19 E+05	4.19 E+05
K	2.82 E+07	1.84 E+07	2.33 E+07
Si		1.45 E+05	1.45 E+05
Na	1.20 E+08	2.06 E+08	1.63 E+08
Np	30.7	< 80.8	< 80.8
Pu	9.09 E-07	1.73 E-06	1.32 E-06
Zn		5.88 E+04	5.88 E+04
Ions	μg/L	μg/L	μg/L
NH_3	8.94 E+04	2.41 E+03	4.59 E+04
CO_3^{-2}	1.62 E+07	1.44 E+07	1.53 E+07
Cl^-	1.38 E+06	3.47 E+06	2.43 E+06
OH^-	5.41 E+07	9.71 E+07	7.56 E+07
F^-	3.25 E+06	1.90 E+06	2.58 E+06
NO_2^-	2.48 E+07	7.08 E+07	4.78 E+07
NO_3^-	1.13 E+08	2.05 E+08	1.59 E+08
PO_4^{3-}	2.33 E+06	9.25 E+05	1.63 E+06
SO_4^{2-}	3.28 E+06	1.76 E+06	2.52 E+06
Radionuclides	μCi/L	μCi/L	μCi/L
^{241}Am	< 1.02	1.59	1.59
^{14}C		2.21	2.21
^{134}Cs	1.60 E+03	3.22 E+03	2.41 E+03
^{137}Cs	1.73 E+05	3.73 E+05	2.73 E+05

Table 2-1. Estimated Waste Composition of Tank 241-AP-105. (2 pages)

Constituent	Estimated Concentration (upper half of tank)	Estimated Concentration (lower half of tank)	Estimated Concentration of Tank 241-AP-105
Radionuclides (cont.)	μCi/L	μCi/L	μCi/L
^{129}I		0.0583	0.0583
^{145}Pm	246		246
$^{239/240}Pu$		0.0592	0.0592
^{90}Sr	311	136	224
^{99}Tc		24.9	24.9
Physical Properties			
Water wt %	70.3	53.2	61.8
Density (g/cm^3)	1.25	1.42	1.34
pH	13.0	13.3	13.2
TOC (μg/L)	2.24 E+06	5.21 E+06	3.73 E+06

2.5.2 Internal Tank Temperatures

Tank 241-AP-105, along with all other AP Farm double-shell tanks, is equipped with approximately 100 thermocouples (thermoelectric temperature measuring devices) in the tank interior, the annular space, and in the concrete outer shell. A thermocouple tree, with 18 thermocouples assembled in a pipe and inserted into a waste tank, is used to monitor the waste temperatures at various levels in the primary tank, usually every two feet. Temperature readings for the tank have been automatically and manually recorded since July 1989 by surveillance analysis computer systems. The maximum waste temperatures from the weekly manual readings have been plotted over time and are presented in Figure 2-4 (Rios, 1994).

It is apparent from the plotted temperature graph in Figure 2-4 that the temperature of the waste in Tank 241-AP-105 exhibits seasonal fluctuations. This is expected since the soil between the surface level and approximately 10 feet below the surface level creates a zone that is thermally transient, thus displaying diurnal and seasonal variations in temperature (Freeze & Cherry, 1979). While it is common for the effects of changing air temperature to be quickly damped out in soil beneath this zone, this is not the case with an underground storage tank. Rather than a solid mass of soil, a double-shell tank is a metal and concrete container filled with liquid, continuously ventilated by a fan driven system, surrounded by an actively ventilated annular space, and connected to the surface by various risers and drywell openings. The net result is a combination of convection and increased conduction which transfers heat to and from the surface. From the thermocouple surveillance data it is evident that the seasonal variations did affect the temperature of the tank contents, even though the bottom of the tank is 60 feet below grade level. It also appears that the temperature cycles have undergone a slight decrease in both peak and average temperatures. Furthermore, the fluctuations in tank waste temperature seem to display the three-month shift from seasonal ambient air temperatures as discussed in Crowe (1993).

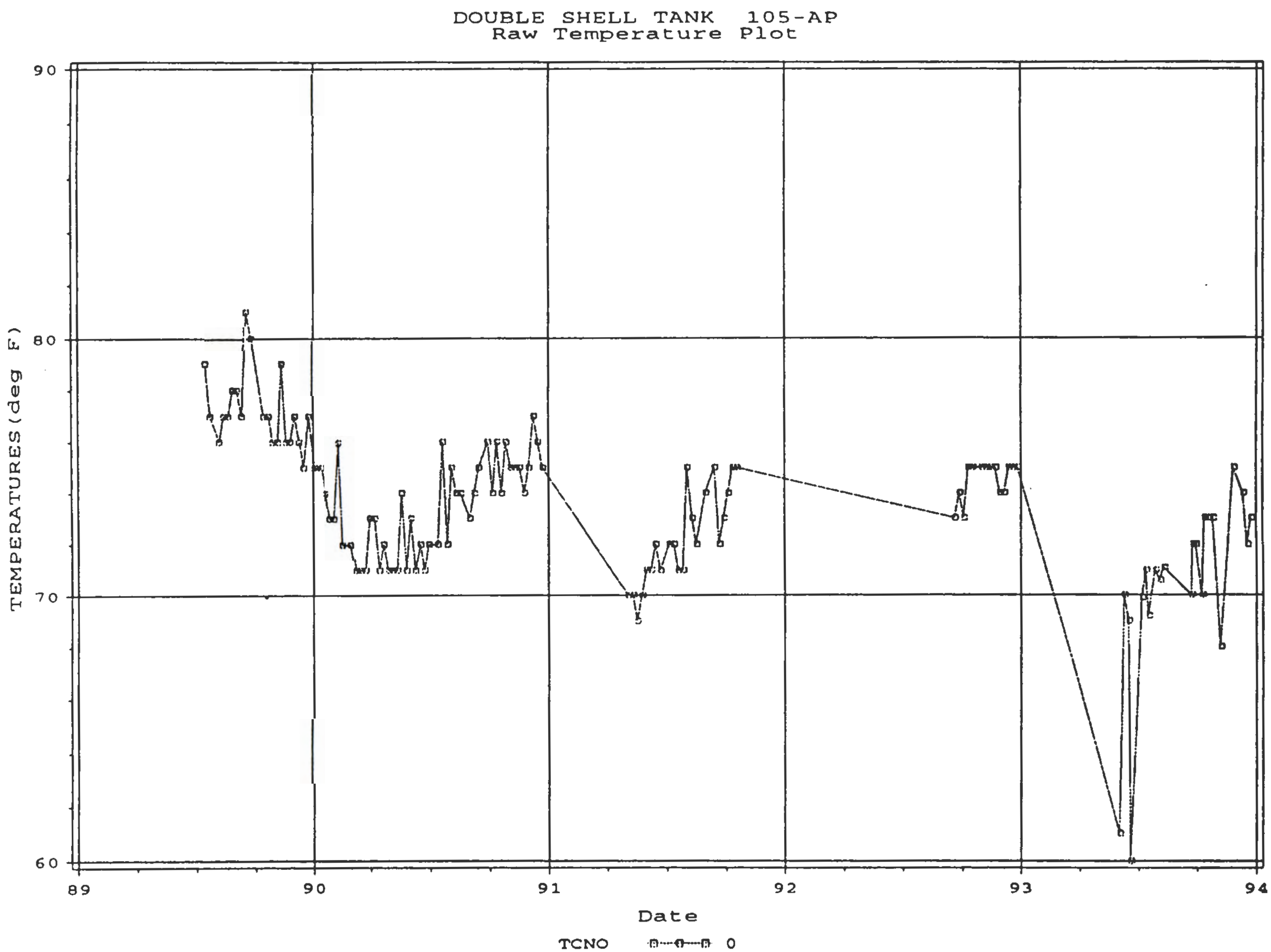


Figure 2-4. Thermocouple Tree Raw Temperature Plot for Tank 241-AP-105 (Rios, 1994).

Except for three periods when the thermocouple equipment was out of service, the internal temperature of Tank 241-AP-105 has been monitored approximately weekly. The three periods with no thermocouple data are from the end of the fourth quarter 1990 to the second quarter 1991, from the third quarter 1991 to the fourth quarter 1992, and from the end of the fourth quarter 1992 to the middle of the second quarter 1993.

As depicted in Figure 2-4, the highest temperature, a peak of 81 °F, appears to coincide with the last transfer of waste into Tank 241-AP-105 during the third quarter of 1989. Since that time, average tank temperatures have decreased slightly and followed the seasonal fluctuation pattern.

Two unusual readings were recorded in the second quarter of 1993. The first, a reading of 61 °F, immediately follows a time period of several months when the thermocouple equipment was out of service. The second, a reading of 60°F, was recorded about three weeks later. Both readings appear to be about nine degrees lower than what would be expected based on the history of the tank and temperatures recorded following the anomalies. Since no waste was added to or taken from Tank 241-AP-105 after the third quarter of 1989, a change in the waste's composition due to a transfer can be eliminated as a possible cause for the inconsistencies. The most likely cause for these anomalies appears to be either an equipment malfunction or an error in recording the readings (i.e., a reading of 70°F could mistakenly have been recorded as 60°F).

3.0 TANK SAMPLING OVERVIEW

Sampling of Tank 241-AP-105 was designed to accomplish two objectives. The first was to provide inorganic, radioactive, and organic information about the tank contents. The second was to determine if the waste, if blended with dilute waste from Tank 241-AP-106, was suitable feed for the Grout Treatment Facility. Blending with the waste in Tank 241-AP-106 was thought to be needed to lower the radiolytic heat generation of the concentrated waste in Tank 241-AP-105.

3.1 DESCRIPTION OF SAMPLING EVENT

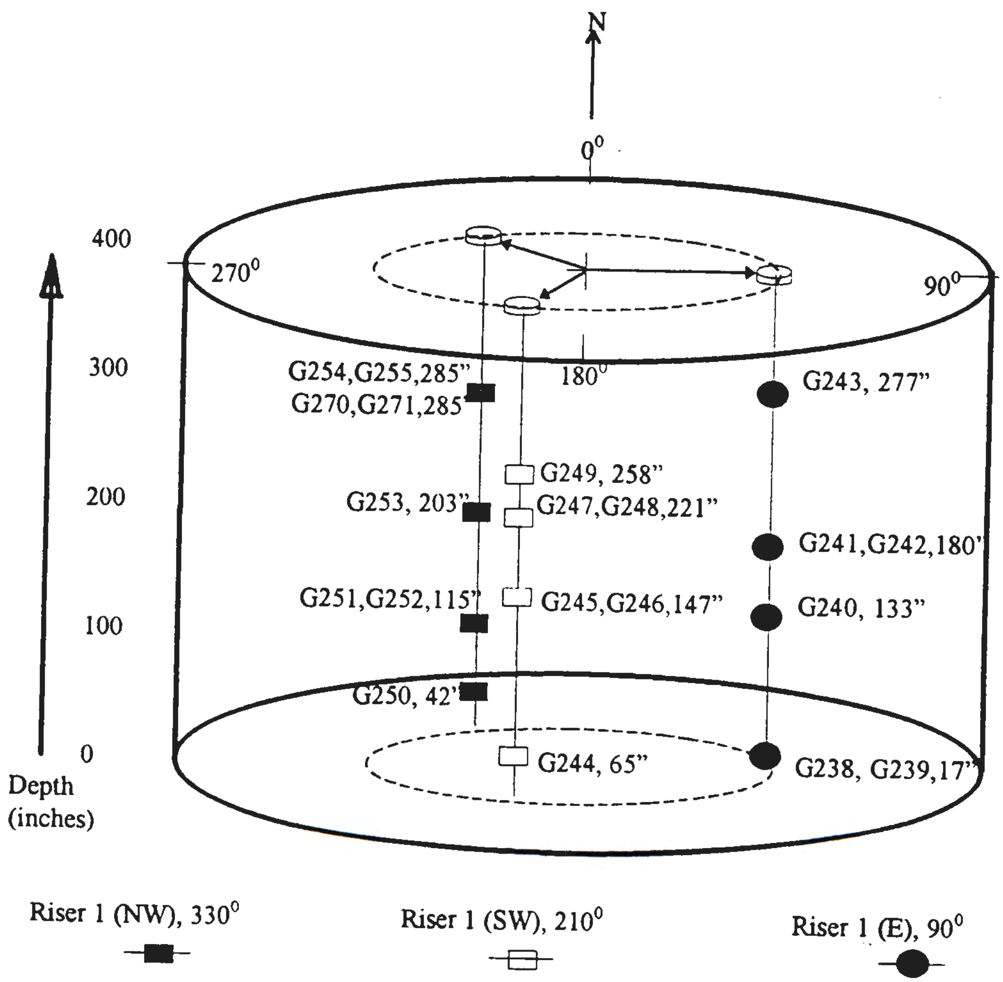
Tank 241-AP-105 was sampled on March 10 and 14, 1993. According to the sampling plan, the waste contained in Tank 241-AP-105 was assumed to consist of two distinct layers. It was also assumed that the waste within each layer was homogeneous (Hendrickson and Welsh, 1992). Therefore, it was determined that a total of six samples from each layer of the tank would adequately represent the inorganic and radionuclide character of the waste. Samples were therefore taken from three equally spaced risers situated 120 degrees apart, at a radius of 20 feet from the tank's center (see Figure 3-1). Samples were obtained by using the "bottle-on-a-string" method. Each glass sample bottle was used to collect approximately 100 milliliters of liquid (The different types of sampling methods used at the Hanford site are discussed in the *Tank Characterization Reference Guide* [De Lorenzo et al., 1994].)

3.2 SAMPLE HANDLING PROCEDURES

To be consistent with safety procedures that help to limit personnel exposure to hazardous ionizing radiation, no attempt was made to ensure completely full bottles; as a result, there was the potential for headspace in all sample bottles. Due to the shielding requirements for the shipping containers, refrigeration of the sample was not possible. Also, the waste was not expected to contain any organic materials that might influence the results of the samples; therefore, no preservatives were used in the sample bottles.

Lack of sample preservation should not impact the validity of the sample results. The majority of the waste in Tank 241-AP-105 has been processed through the evaporator and stored in the tank for a number of years at temperatures at or above ambient conditions with active ventilation. The sample handling required due to the radioactivity of the waste did not cause the sample to be subjected to a more rigorous environment (for volatile component removal) than was present in the tank. Therefore, the additional time at ambient temperature after sampling should not affect the validity of the sample results. This assertion is supported by recent work in the establishment of holding times for sample analyses (Maskarinec et. al., 1990). For the same reasons, the headspace and lack of sample refrigeration also should not have had a serious impact on the sample results.

Figure 3-1. Tank 241-AP-105 Sample Locations and Tank Farm Numbers.



3.3 REQUESTED ANALYSES

Thirteen samples (twelve samples and one duplicate) were submitted to the Westinghouse Hanford Company 222-S Processing and Analytical Laboratory for analysis (see Table 3-1). These samples were used to characterize the inorganic and radiochemical properties of the tank. In addition, eight samples (seven samples and a field blank) were shipped to the Pacific Northwest Laboratory (see Table 3-2), where they were analyzed for organic constituents. A list of the analytes evaluated in each sample by laboratory is presented in Table 3-3.

Table 3-1. WHC Sample Numbers for Tank 241-AP-105 (Welsh, 1994).

Riser, Angle	Depth (from tank bottom) in inches	Position	Tank Farm Sample Number	Laboratory Sample Number
1 (East), 90°	277	1	G243	G409
	180	2	G241	G407
	133	3	G240	G402
	17	4	G238	G401
1 (SW), 210°	2	5	G249	G418
	58	6	G248	G417
	221	7	G245	G413
	147	8	G244	G412
	65			
1 (NW), 330°	285	9A	G254	G396
	285	9B	G271	G397
	203	10	G253	G392
	115	11	G251	G391
	42	12	G250	G422
Composite*	--	Composite	Composite	G378
		Composite	Composite	G379

*Composite sample consisted of all 13 samples.

Table 3-2. PNL Sample Numbers for Tank 241-AP-105 (Welsh, 1994).

Riser, Angle	Depth (from tank bottom) in inches	Position	Tank Farm Sample Number	Laboratory Sample Number
1 (East), 90°	180 17	2 4	G242 G239	93-05388 93-05387
1 (SW), 210°	221 147	6 7	G247 G246	93-05390 93-05389
1 (NW), 330°	285 285 115	9A 9B 11	G255 G270 G252	93-05393 93-05392 93-05391
Field Blank			G273	93-05394

Table 3-3. Tank 241-AP-105 Samples and the Requested Analytes Evaluated (Welsh, 1994).

Tank Farm Sample Numbers	Laboratory Sample Numbers	Laboratory	Requested Analytes
G251 G250 G254 G271 G238 G240 G241 G243 G244 G254 G248 G249 G250	G391 G392 G396 G397 G401 G402 G407 G409 G412 G413 G417 G418 G422	222-S Laboratory	Al, Sb, Ba, Be, Cd, Cr, Fe, Ni, K, Na, P, Pb, Se, Ag, F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, ^{137}Cs, ^{134}Cs, ^{60}Co, $^{144}Ce/Pr$, ^{125}Sb, $^{106}Ru/Rh$, ^{94}Nb, SpG, % H_2O, TIC, TOC, ^{241}Am, ^{99}Tc, ^{14}C, ^{90}Sr, ^{237}Np, ^{238}Pu, $^{239/240}Pu$, $^{243/244}Cm$, ^{129}I
Composite Samples	G378, G379	222-S Laboratory	Al, As, Hg, Sb, Ba, Be, Cd, Cr, Fe, Ni, K, Na, P, Pb, Ag, Se, F^-, Cl^-, OH^-, CN^-, NO_2^-, NO_3^-, PO_4^{3}, SO_4^{2-}, NH_3/NH_4^+, ^{137}Cs, ^{134}Cs, ^{60}Co, $^{144}Ce/Pr$, ^{125}Sb, $^{106}Ru/Rh$, ^{94}Nb, SpG, % H_2O, TOC, ^{241}Am, ^{99}Tc, ^{90}Sr, ^{237}Np, $^{243/244}Cm$, ^{129}I, U, ^3H
G239 G242 G246 G247 G252 G270 G255 G273	93-05387 93-05388 93-05389 93-05390 93-05391 93-05392 93-05393 93-05394	PNL	Volatiles, Semi-volatiles, EDTA, HEDTA, Citrate, Oxalate, Glycolate

EDTA: ethylenediaminetetraacetic acid.
HEDTA: N-(2-hydroxyethyl)ethylenediaminetriacetic acid.

4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME

This chapter focuses on the handling of the samples after the sampling event and the analytical procedures performed on the samples. In addition, the characterization program analyses specific to Tank 241-AP-105 are discussed.

4.1 WASTE DESCRIPTION

At the time of collection, the waste was thought to have two separate layers that were assumed to be homogeneous within layers (Hendrickson and Welsh, 1992). According to Sample Receipt Forms (Hosaka, 1993), Sample G255 had an oily liquid present in the sample, but no contamination was found. Also, Sample G238 and G239 were received with two phases (liquid and solid) present (Welsh, 1994). No other information was located regarding the description of the waste in each sample. Homogeneity of the waste is further discussed in Section 7.2.

4.2 HOLD TIME CONSIDERATIONS

For a description of hold time considerations, see the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

4.2.1 WHC - Processing and Analytical Laboratories

Tank 241-AP-105 was sampled on March 10 and 14, 1993. The samples were delivered to the WHC-222-S Processing and Analytical Chemistry Laboratory on June 3, 1993 for inorganic and radiochemical analyses. The samples were received at ambient temperature with potential headspace (see Section 3).

4.2.2 Pacific Northwest Laboratory - Analytical Chemistry Laboratory

Eight samples from Tank 241-AP-105 were received by PNL Analytical Chemistry Laboratory on June 22, 1993, for volatile (VOA), semi-volatile (SVOA), glycolate, oxalate, EDTA/HEDTA, and citrate analyses. The samples were refrigerated upon receipt. The documentation for VOA stated that the analysis was performed within a 14-day holding time based on sample receipt but not from sample extraction date (Hosaka, 1993). The SVOA was performed on July 8, 1993, EDTA/HEDTA and citrate analyses were performed on September 10, 1993, and oxylate and glycolate were performed on September 8 and 9, 1993, respectively. As noted by the dates, all defined holding times were exceeded based upon the date the tank was sampled (March 10 and 14, 1993).

4.3 SAMPLE PREPARATION

A discussion concerning sample preservation is provided in the *Tank Characterization Reference Guide* (De Lorenzo et al., 1994).

4.4 ANALYTICAL METHODS

This section briefly describes the analytical methods used to characterize the waste in Tank 241-AP-105. The overall character of the waste is based on the analyses of the individual and composite samples. Table 4-1 lists the analytical methods used to determine the presence of each constituent.

4.4.1 Physical Tests

Physical tests performed on the samples included weight percent water and specific gravity (SpG). The weight percent water procedure used approximately 1 milliliter of sample, which was heated in an oven at 120°C until gravimetric measurements could be made. Procedure LA-564-101, Rev. E-3 was used for this analysis. This is a later revision than specified in the Technical Project Plan (Procedure LA-564-101, Rev. E-1) because the procedure had to be modified to allow for calculating wt% solids rather than percent water. Therefore, this procedure applies to the determination of total dissolved solids/percent water in solutions, slurries, and solid waste. The weight percent water was performed on all individual and composite samples in duplicate. The specific gravity analysis was performed on full characterization samples and the composite samples.

Table 4-1. Analytical Methods. (Hendrickson and Welsh, 1992, St. Denis, 1993, and Welsh, 1994)

Analyte	Method	Procedure
Hg	CVAA[1]	LA-325-104
As, Se	GHAA[2]	LA-355-131 LA-365-131
$^{238,239,240}Pu$, ^{241}Am, $^{243/244}Cm$	separation/AEA	LA-503-156 LA-508-051
Ag, Ba, Cd, Cr, Na, Ni, K, Pb, P, Al, Be, Sb, Fe	Inductively Coupled Plasma	LA-503-156 LA-508-051 LA-505-151
U	Laser Fluorimetry	LA-925-106
NH_3/NH_4^+	see[4]	LA-634-102
CN^-	Dist/Spec[5]	LA-695-102
F^-, Cl^-, NO_2^-, NO_3^-, SO_4^{2-}, PO_4^{3-}	Ion Chromatography	LA-533-105
TOC	see [6]	LA-344-105
TIC	see [7]	LA-622-102
$^{89,90}Sr$	separation/Beta[8]	LA-220-101
^{99}Tc	extraction/LSC[9]	LA-438-101
^{14}C	distillation/LSC	LA-348-104
^{134}Cs, ^{137}Cs, ^{94}Nb, $^{106}Ru/Rh$, ^{125}Sb, $^{144}Ce/Pr$, ^{60}Co	GEA	LA-548-121 LA-508-052
^{237}Np	extraction/alpha[10]	LA-933-141
^{129}I	extraction/GEA[11]	LA-378-103
^{3}H	separation/LSC	LA-218-114
% H_2O	Oven drying	LA-564-101
OH^-	Potentiometric Autotitration	LA-661-102
SpG	Density Measurement	LA-510-112

[1]Cold Vapor Atomic Absorption
[2]Gaseous Hydride Atomic Absorption Spectrophotometer
[3]Chemical Separation (anion exchange resin) and Alpha Energy Analysis
[4]Distillation into a weak acid receiver and detection by back titration with a strong acid
[5]Acidification and Distillation followed by Spectrophotometric analysis
[6]Use TIC leftover carbon; TOC concentration measured by combustion and detection of CO_2 by coulometry
[7]Acidify, purge, and heat sample; detect CO_2 using coulometry
[8]Chemical Separation along with total Beta Proportional Counting
[9]Extraction process followed by Liquid Scintillation Counting
[10]Extraction process followed by Alpha Proportional Counting
[11]Extraction process followed by Gamma Energy Analysis

4.4.2 Homogeneity of Waste

The reason for the interest in tank homogeneity is that if the waste is homogeneous, then the composite sample can be formed using equal volumes from all samples. However, the waste in Tank 241-AP-105 had the possibility of being in two discrete layers and it was determined that the waste was not homogeneous (Welsh, 1994). For a more in depth discussion, see Section 7-2 of this characterization report.

4.4.3 Chemical and Radionuclide Constituent Analysis

Thirteen of the twenty samples obtained from Tank 241-AP-105 were analyzed for chemical and radionuclide constituents. The thirteen samples consisted of four samples from each riser and one duplicate. From the thirteen selected samples, a composite was made and two sub-samples were prepared, for a total of fifteen samples analyzed. The composite sample was prepared using equal volumes from each of the (not the field duplicates) inorganic samples. This was due to the assumptions that the tank waste consisted of two layers that would be homogeneous within layers, but heterogeneous between layers (Hendrickson and Welsh, 1992). A comparison of the means computed from individual sample results and the composite means determined that the data for all analytes except Cd and K was equivalent.

4.4.4 Volatile and Semi-Volatile Organic Constituent Analysis

Seven samples (six samples plus one duplicate) of waste from Tank 241-AP-105 were analyzed for volatile and semi-volatile constituents by PNL. Both the volatile and semi-volatile organic compounds were analyzed using gas chromatography/mass spectrometry. The glycolate and oxalate were analyzed using high performance liquid chromatography as explained in detail below (Hendrickson and Welsh, 1992):

- Rapid screening by headspace/gas chromatography to establish laboratory dilution requirements. PNL procedure PNL-ALO-331 is a modified version of EPA method 3810 (EPA, 1986).

- Gas chromatography/mass spectrometry (GC/MS) analysis of volatile organic component. PNL procedure PNL-ALO-335 follows the USEPA Contract Laboratory Program Statement of Work (EPA, 1991).

- Gas chromatography/mass spectrometry (GC/MS) for semi-volatile component analysis. PNL procedure PNL-ALO-345 follows the Contract Laboratory Program protocol (EPA, 1991).

- Organic Complexants - glycolate and oxalate were analyzed using liquid chromatography. Citrate, HEDTA, and EDTA were analyzed using high performance liquid chromatography (Welsh, 1994).

Quality assurance techniques of the EPA methods cited were followed as closely as technically feasible. Section 5 of this report further addresses the quality assurance samples results from the analyses performed above.

4.4.5 Grout Product Tests

A portion of Tank 241-AP-105 waste was blended with dilute waste from 241-AP-106 according to the test plan (Hendrickson and Welsh, 1992) under the direction of Grout technology personnel. For this setup, a mixture of 20% of Tank 241-AP-106 waste was blended with 80% of Tank 241-AP-105 waste.

The blend was mixed with the formulation developed for Tank 241-AP-102 waste (Lokken et al., 1993). The formulation consisted of 21% Type II Portland cement, 11% attapulgite clay, and 68% Class F fly ash. This particular formulation did not produce acceptable grout with this waste mixture (Welsh, 1994).

4.5 MODULE SPECIFIC ANALYSES

The characterization program for Tank 241-AP-105 was intended to satisfy criteria set by the Hanford Grout Disposal Program, one of the program elements of the Tank Waste Remediation System (TWRS) designed for the retrieval and final disposal of low-level wastes. The TWRS sample characterization objectives are to provide adequate characterization of physical, chemical and radiological properties of Hanford Site tank wastes to support the resolution of Unreviewed Safety Questions, other safety issues surrounding the Watch List tanks, and the design of retrieval, pretreatment and final disposal systems (Bell, 1994). The needs of the Hanford Grout Disposal Program are separate and in addition to those of the TWRS.

The waste from Tank 241-AP-105 was designated as potential feed for the recently terminated Grout Treatment Facility. Having received this designation, the waste in Tank 241-AP-105 was sampled, analyzed and tested to determine feed processability and to demonstrate compliance with regulatory requirements. The analytical requirements for the Grout Program entailed the determination of the waste's suitability for disposal as grout. Also included was the determination of the grout product's physical and chemical characteristics to satisfy regulatory compliance. The sampling and analysis plan for Tank 241-AP-105 included characterization for metals, water-soluble ions, volatile and semi-volatile organic compounds, and radionuclides of the grout feed, as well as analyses of and the grout product characteristics.

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5.0 ANALYTICAL RESULTS AND WASTE INVENTORY

The chemical, radiochemical, physical and organic results associated with Tank 241-AP-105 are presented within this document as indicated in Table 5-1. The samples from which these results were derived were collected on March 10 and 14, 1993. This sampling event was the most recent regarding Tank 241-AP-105 and reflected the most accurate characterization of the tank waste available at the present time. A detailed discussion of the sampling process was presented in Section 3.

Table 5-1. Analytical Data Presentation Tables.

Analysis	Tabulated Results
Metals	Table A-1
Anions	Table A-2
Radionuclides	Table A-3
Organic Complexants	Table A-4
Physical and General Chemical Data	Table A-5
Volatile Organics	Table A-6
Semivolatile Organics	Table A-7
Tank Characterization Report Results	Table 5-6

In cases where a duplicate analysis was performed on a sample, the data presented in the Appendix A tables were obtained by calculating an average concentration value from the initial and duplicate results. If an analyte was detected by the original but not by the duplicate sample evaluation, or vise-versa, only the single positive result was reported. When both sample runs failed to detect an analyte, the detection limit preceded by a less than (<) sign was recorded as the sample result.

A representative tank concentration for each analyte was included with the Appendix A tables. Most of these values were derived according to a statistical model (Welsh, 1994) and were accompanied by a standard error estimate. When the statistical model could not be applied to due insufficient data, representative tank concentrations were obtained by calculating simple averages. If all available sample analyses failed to detect a particular analyte, the tank concentration of the analyte was reported to be less than the highest recorded detection limit. Detection limit values were not utilized in any of the calculations from which representative tank concentration values and standard error estimates were derived.

The range of the tabulated sample data associated with each analyte was also included in the Appendix A table. The projected tank inventory value reported in the Appendix A tables was obtained by multiplying the representative tank concentration of each analyte by the volume of waste in the tank. At the time of sampling, the tank contained 3.11E+06 liters of waste. The appropriate conversion factors were included in the calculations to obtain the reported units.

5.1 CHEMICAL ANALYSES

5.1.1 Elemental Constituents

The major waste constituents identified by inductively coupled plasma spectroscopy were Al, Sb, Ba, Be, Cd, Cr, Fe, Pb, Ni, P, K, Ag and Na. Arsenic and selenium were determined by gaseous hydride atomic absorption spectroscopy, while mercury was analyzed by cold vapor atomic absorption spectroscopy. The laser fluorimetry method was utilized to evaluate uranium.

Aluminum, potassium, and sodium were the analytes present in the greatest concentration; each had concentrations over 8,000 ppm. Mercury was the only elemental constituent which was not detected by the laboratory methods.

Historical estimates (from Table 2-1) for Al, Cr, Fe, K and Na were available for comparison with the recent analytical data. A historical comparison regarding phosphorous is discussed in Section 5.1.2 along with phosphate. The corresponding relative percent differences between the two sources of data are presented in Table 5-2. As can be seen, there is excellent corroboration for the Na data, and moderate agreement for all of the other analytes except Al, which reflected poor agreement for the two sources.

Table 5-2. Comparison of Analytical and Historical Data for Elemental Constituents.

Analyte	Lab Result (μg/L)	Historical Estimate (μg/L)	Relative Percent Difference
Al	1.17E+07	4.81E+06	83.5%
Cr	1.87E+05	2.67E+05	35.2%
Fe	6,600	9,670	37.7%
K	3.10E+07	2.33E+07	28.4%
Na	1.67E+08	1.63E+08	2.42%

5.1.2 Anions

The most abundant anion of the Tank 241-AP-105 waste is nitrate. Carbonate, chloride, hydroxide, nitrite, and sulfate were present in concentrations above 1000 ppm; also present in lesser amounts were cyanide and phosphate. Ammonia was not detected by the laboratory analyses. The ion chromatography (IC) data was inconclusive as to whether or not fluoride was present in Tank 241-AP-105 since an unidentified compound coeluted with fluoride and interfered with peak integration. A single composite sample was then analyzed by an ion selective electrode technique.

Only the composite samples were utilized to evaluate ammonia, cyanide, and hydroxide. Since ammonia was not detected in the tank waste, a value reflecting a concentration of less than 40,000 μg/L, the detection limit, was recorded. As shown in Table A-2 of Appendix A, representing a recent inventory of Tank 241-AP-105 based on samples collected in March 1993, the hydroxide concentrations of two composite samples were determined to be 54.8 g/L (3.22 M), and 53.1 g/L (3.12 M), yielding a mean hydroxide concentration of 54.0 g/L (3.18 M). The resulting pH value calculated from each of the three concentrations is 14.5. In comparison, historical data taken from Hendrickson and Welsh (1992), listed in Table 2-1, reported a hydroxide concentration of 54.1 g/L (3.18 M) for the upper half of the tank and 97.1 g/L (5.71 M) for the lower half, yielding a mean value of 75.6 g/L (4.44 M). The resulting pH values calculated from these three concentrations are 14.5, 14.8, and 14.6, respectively. The pH values calculated from historical as well as more recent hydroxide concentration data have consistently remained in the range of 14.5-14.8. The historical pH measurements taken by pH meter (Table 2-1), however, are found to be lower, ranging from 13.0 to 13.3. It can thus be concluded that the pH of the waste in Tank 241-AP-105 has remained relatively constant during the time period between the sampling events leading to the historical data and those leading to the more recent data. The two pH ranges obtained are most likely due to the discrepancy in methods of pH determination and not to an actual change in pH.

Solution behavior for multicomponent systems with high ionic contents is not well quantified. The pH value determined from the hydroxide concentration is probably more representative of the tank waste conditions, of the two value ranges presented. Conventional pH meters are often neither sufficiently accurate nor calibrated correctly for strongly alkaline, high ionic strength solutions. However, solutions with pH values near or above 14 are uncommon. Simply calculating the pH value from the hydroxide concentration, without accounting for phase equilibrium conditions, may also be incorrect. For this tank, the pH of the waste is in excess of 13, and may be as high as 14.5.

The phosphorous data from the inductively coupled plasma (ICP) analyses were converted into phosphate values for comparison with the IC phosphate data. This comparison is presented in Table 5-3. As can be seen, the IC phosphate result is low when compared with the ICP result and historical estimate.

Also included in Table 5-3 are comparisons between the analytical data and historical estimates for ammonia, chloride, fluoride, hydroxide, nitrate, nitrite and sulfate. As indicated by the table, generally the values agreed well. There was excellent agreement between the two sources of data for chloride, nitrate, nitrite, and sulfate; each had a relative percent difference between the analytical and historical data of less than 5%. Only the phosphate and fluoride comparisons exhibited relative percent differences over 50%.

5.2 RADIOLOGICAL DETERMINATIONS

The most plentiful radioactive constituent in Tank 241-AP-105 was ^{137}Cs. Also present in detectable concentrations were ^{241}Am, ^{14}C, ^{134}Cs, ^{129}I, ^{237}Np, $^{239/240}$Pu, ^{145}Pm, ^{90}Sr, ^{99}Tc, and ^{3}H. Those analytes not detected by the laboratory included ^{125}Sb, ^{144}Ce/Pr, ^{60}Co, $^{243/244}$Cm, ^{94}Nb, ^{238}Pu, and ^{106}Ru/Rh. Historical estimates for comparison with the recent analytical data were available for ^{241}Am, ^{14}C, ^{134}Cs, ^{137}Cs, ^{129}I, $^{239/240}$Pu, ^{90}Sr, and ^{99}Tc. This comparison is displayed in Table 5-4. As is evident from the table, the two sources of data did not demonstrate good agreement; only the ^{90}Sr and ^{137}Cs data had a relative percent difference below 20%.

Table 5-3. Comparison of Analytical and Historical Results for Tank 241-AP-105 Anions.

Analyte	Lab Result (μg/L)	Historical Estimate (μg/L)	Relative Percent Difference
Ammonia	< 40,000	45,900	13.7%
Chloride	2.36E+06	2.43E+06	2.92%
Fluoride	1.52E+06	2.58E+06	51.7%
Hydroxide	5.40E+07	7.56E+07	33.3%
Nitrate	1.65E+08	1.59E+08	3.70%
Nitrite	4.83E+07	4.78E+07	1.04%
Phosphate (IC)	4.40E+05	1.63E+06	115%
Phosphate (ICP)	9.68E+05	1.63E+06	51.0%
Sulfate	2.42E+06	2.52E+06	4.05%

Table 5-4. Comparison of Analytical and Historical Isotopic Results.

Analyte	Lab Result (μCi/L)	Historical Estimate (μCi/L)	Relative Percent Difference
^{241}Am	0.408	1.59	118%
^{14}C	0.217	2.21	164%
^{134}Cs	522	2,410	129%
^{137}Cs	2.27E+05	2.73E+05	18.4%
^{129}I	0.152	0.0583	89.1%
$^{239/240}Pu$	0.158	0.0592	91.0%
^{90}Sr	208	224	7.41%
^{99}Tc	69.8	24.9	94.8%

5.3 ORGANIC CONSTITUENTS

With the exception of acetone, none of the target analytes associated with the volatile and semi-volatile organic analyses were detected in Tank 241-AP-105. Because of their volatile nature and relatively small contribution to the waste as indicated by the historical records, the appearance of these compounds was not expected.

The total organic carbon (TOC) analysis revealed the presence of 2570 mg/L of carbon in Tank 241-AP-105; the relative percent difference between this result and the historical estimate was 30%. A list of organic complexants which were expected to account for some of the total organic carbon detected in the tank waste is presented in Table 5-5; the concentration of each ligand and the concentration of carbon associated with each ligand were also reported.

Table 5-5. Organic Complexant Concentration Data.

Complexant or Ligand	mass of COMPLEXANT per liter (mg/L)	mass of CARBON per liter (mg/L)
Citrate	450	171
EDTA	124	51.7
HEDTA	15.9	6.94
Glycolate	607	194
Oxalate	521	142
Total Carbon From Analyzed Complexants		566

As demonstrated in the table, the amount of carbon attributable to these complexants is 566 mg/L and accounts for approximately 21% of the 2750 mg/L TOC value. Since the organic carbon contribution from volatile and semi-volatile organic compounds in Tank 241-AP-105 is negligible, the remaining organic carbon in the waste is attributed to the presence of additional complexants, either intact molecules or decomposition products.

5.4 PHYSICAL PROPERTIES

5.4.1 Specific Gravity and Weight Percent Water

The specific gravity of the tank was determined to be 1.34, and the weight percent of water was 60.3%.

5.4.2 Rheology

Due to the lack of rheological estimates, the viscosity of the tank was estimated. The specific gravity of the waste is 1.333, and the tank is approximately 60% water, by weight. Since a 40%, by weight, sodium nitrate solution has a specific gravity of 1.32, its corresponding viscosity of 2.23 centipoise was estimated to be the viscosity of the waste. The viscosity, however, should be determined experimentally before conducting retrieval operations.

5.4.3 Energetics

Differential scanning calorimetry analyses were not requested nor conducted since the potential for an exothermic reaction is unlikely due to the high water content of the tank waste.

5.5 DATA PRESENTATION

The Tank Characterization Report Results recorded in Table 5-6 are the final constituent estimates for this document. The values are equal to the representative tank concentrations presented in the Appendix A tables. If laboratory results were not available for an analyte, the Tank Characterization Report Result was, if possible, derived from historical data.

Table 5-6. Tank Characterization Report Data for Double-Shell Tank 241-AP-105. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Metals	**(μg/L)**	**(μg/L)**	**(μg/g)**	**(kg)**
Aluminum (Al)	4.81E+06	**1.17E+07**	**8,780**	36,400
Antimony (Sb)	---	**6,760**	**5.07**	21.0
Arsenic (As)	---	**909**	**0.682**	2.83
Barium (Ba)	---	**638**	**0.479**	1.98
Beryllium (Be)	---	**1,460**	**1.10**	4.54
Bismuth (Bi)	---	---	---	---
Boron (B)	21,400	**21,400**	**16.1**	66.5
Cadmium (Cd)	---	**1,770**	**1.33**	5.50
Calcium (Ca)	66,600	**66,600**	**50.0**	207
Chromium (Cr)	2.67E+05	**1.87E+05**	**140**	582
Copper (Cu)	---	---	---	---
Iron (Fe)	9,670	**6,600**	**4.95**	20.5
Lead (Pb)	---	**5,390**	**4.04**	16.8
Magnesium (Mg)	9,090	**9,090**	**6.82**	28.3
Manganese (Mn)	---	---	---	---
Mercury (Hg)	---	**< 25.0**	**0.0188**	< 0.0780
Molybdenum (Mo)	---	---	---	---
Neptunium (Np)	< 80.8	**< 80.8**	**< 0.0606**	< 0.251
Nickel (Ni)	---	**10,900**	**8.18**	33.8
Phosphorus (P)	4.19E+05	**3.16E+05**	**237**	983
Potassium (K)	2.33E+07	**3.10E+07**	**23,300**	96,400
Selenium (Se)	---	**141**	**0.107**	0.439
Silicon (Si)	1.45E+05	**1.45E+05**	**109**	451

Table 5-6. Tank Characterization Report Data for Double-Shell Tank 241-AP-105. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Metals (continued)	(μg/L)	(μg/L)	(μg/g)	(kg)
Silver (Ag)	---	**139**	**0.104**	0.432
Sodium (Na)	1.63E+08	**1.67E+08**	**1.25E+05**	5.19E+05
Titanium (Ti)	---	---	---	---
Uranium (U)	---	**42,200**	**31.7**	131
Zinc (Zn)	58,800	**58,800**	**44.1**	183
Zirconium (Zr)	---	---	---	---
Ions	(μg/L)	(μg/L)	(μg/g)	(kg)
Ammonia (NH_3)	45,900	**< 40,000**	**< 30.0**	< 124
Carbonate (CO_3^{2-})	1.53E+07	**2.25E+07**	**16,800**	70,000
Chloride (Cl^-)	2.43E+06	**2.36E+06**	**1,770**	7,340
Cyanide (CN^-)	---	**18,300**	**13.7**	56.9
Fluoride (F^-)	2.58E+06	**1.52E+06**	**1,140**	4,730
Hydroxide (OH^-)	7.56E+07	**5.40E+07**	**40,500**	1.68E+05
Nitrate (NO_3^-)	1.59E+08	**1.65E+08**	**1.24E+05**	5.13E+05
Nitrite (NO_2^-)	4.78E+07	**4.83E+07**	**36,200**	1.50E+05
Phosphate (PO_4^{3-})	1.63E+06	**4.40E+05**	**330**	1,370
Sulfate (SO_4^{2-})	2.52E+06	**2.42E+06**	**1,820**	7,530
Radionuclides	(μCi/L)	(μCi/L)	(μCi/g)	(Ci)
^{241}Am	1.31	**0.408**	**3.06E-04**	1.27
^{125}Sb	---	**< 699**	**< 0.524**	< 2,170
^{14}C	2.21	**0.217**	**1.63E-04**	0.675
^{144}Ce/Pr	---	**< 1,300**	**< 0.975**	< 4,040
^{134}Cs	2,410	**522**	**0.392**	1,620
^{137}Cs	2.73E+05	**2.27E+05**	**170**	7.06E+05
^{60}Co	---	**< 43.3**	**< 0.0325**	< 135
$^{243/244}$Cm	---	**< 0.637**	**< 4.78E-04**	< 1.98
^{129}I	0.0583	**0.152**	**1.14E-04**	0.473
^{237}Np	---	**0.314**	**2.36E-04**	0.977
^{94}Nb	---	**< 45.7**	**< 0.0343**	< 142
^{238}Pu	---	**< 0.898**	**< 6.74E-04**	< 2.79

Table 5-6. Tank Characterization Report Data for Double-Shell Tank 241-AP-105. (3 pages)

Analyte	Historic Tank Content Estimate	Tank Characterization Report Result		Total Tank Inventory
Radionuclides (continued)	(µCi/L)	**(µCi/L)**	**(µCi/g)**	(Ci)
$^{239/240}Pu$	0.0592	**0.158**	**1.19E-04**	0.491
^{145}Pm	246	**246**	**0.185**	765
$^{106}Ru/Rh$	---	**< 2,400**	**< 1.80**	< 7,470
^{90}Sr	224	**208**	**0.156**	647
^{99}Tc	24.9	**69.8**	**0.0524**	217
^{3}H	---	**3.87**	**0.00290**	12.0
Organic Complexants	mg/L	**mg/L**	**mg/g**	kg
EDTA	---	**124**	**0.0930**	385
HEDTA	---	**15.9**	**3.39**	49.3
Citric Acid	---	**450**	**0.338**	1,400
Glycolate	---	**607**	**0.455**	1,890
Oxalate	---	**521**	**0.391**	1,620
Physical Properties				
Water (wt%)	61.8%	**60.3%**	---	N/A
pH	13.2	**14.5**	---	N/A
Specific Gravity	1.34	**1.333**	---	N/A
TIC	---	**4.49E+06 (µg/L)**	**3,370 (µg/g)**	14,000 (kg)
TOC	3.73E+06 (µg/L)	**2.75E+06 (µg/L)**	**2,060 (µg/g)**	8,550 (kg)

6.0 ANALYTICAL RESULT INTERPRETATION

6.1 TANK WASTE PROFILE

Examination of the analytical results reveals that the waste in Tank 241-AP-105 is a solution consisting of approximately 60% water and 40% dissolved salts. Since solid material was present in samples G238 and G239, as discussed in Section 4.1, a sludge layer may be present at the bottom of the tank. The sample data however, was not sufficient to verify nor characterize the potential sludge layer. The most abundant ions in the tank are aluminum, potassium, sodium, nitrite, nitrate, and hydroxide; carbonate, as indicated by the total inorganic carbon analysis, is also present at a relatively high concentration. Radionuclides which demonstrated a detectable activity included ^{241}Am, ^{14}C, ^{134}Cs, ^{137}Cs, ^{129}I, ^{90}Sr, ^{99}Tc, and ^{3}H; ^{137}Cs was the most abundant isotope. The following organic chelating compounds were also found in the waste: EDTA, HEDTA, citrate, glycolate, and oxalate.

6.2 WASTE SUMMARY AND CONDITIONS

6.2.1 Projected Tank Heat Load

The low relative level of radionuclides in Tank 241-AP-105 is reflected in the low heat load as presented in Table 6-1. Eight of the elements tested for were detected by the analytical methods used. Detection limits for the other analytes were included in the calculation in order to obtain the most conservative estimate possible.

Table 6-1. Tank 241-AP-105 Radionuclide Inventory and Heat Load.

Radionuclide	Ci	Watts
^{241}Am	1.27	0.0417
^{125}Sb	< 2,170	< 7.25
^{144}Ce/Pr	< 4,040	< 32.4
^{134}Cs	1,620	16.52
^{137}Cs	7.06E+05	3,300
^{60}Co	< 135	< 2.08
$^{243/244}$Cm	< 1.98	< 0.0681
^{129}I	0.473	2.21E-04
^{237}Np	0.977	0.0281
^{238}Pu	< 2.79	< 0.0910
$^{239/240}$Pu	0.491	0.0150
^{106}Ru/Rh	< 7,470	< 72.1
^{90}Sr	647	4.33
^{99}Tc	217	0.109
Watts		**~ 3,470**

6.2.2 Regulatory Limits

The cadmium, chromium, and lead concentrations in Tank 241-AP-105 exceeded their corresponding Toxicity Characteristic Leaching Procedure threshold values defined in the *Code of Federal Regulations*, 40 CFR Part 261 (EPA, 1990). The calculated pH of 14.5 is above the Resource Conservation and Recovery Act pH limit of 12.5 for corrosivity (EPA, 1990).

6.3 PROGRAM ELEMENT SPECIFIC ANALYSES

The sampling and analysis of Hanford Site waste tanks is driven by the need to satisfy the characterization requirements of the various Tank Waste Remediation System (TWRS) program elements. These characterization needs are implemented and documented through the Data Quality Objective (DQO) process, and expressed in a series of program specific DQO documents. The data needs are summarized in the *TWRS Tank Waste Analysis Plan* (Bell, 1994).

This Tank Characterization Report is the final step in the characterization of Tank 241-AP-105. According to the process and issue based data requirements, the inventory estimates and waste properties contained in this report can be applied to the data requirements of the various program elements. Contained in Table 6-2 is a summary of which program data needs are fulfilled through this characterization of the waste in Tank 241-AP-105, based on a review of the stated sampling and analysis requirements. In the future, the applicability of Tank Characterization Report results to each TWRS program element will be documented in tank specific Tank Characterization Plans, prior to the tank sampling.

Table 6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements. (2 pages)

Data Quality Objective	Applicability to Characterization of Tank 241-AP-105
Tank Safety Screening	applies[1]
Ferrocyanide Safety Issue	does not apply
Flammable Gas Tanks Crust Burn Issue	does not apply
Generic Tank Vapor Issue Resolution	not addressed
Flammable Gas Tank	not completed
Waste Compatibility	applies
Organic Fuel Rich Tank	does not apply
Rotary Core Vapor Sampling	does not apply
Evaporator Operations	not completed
Process Control	not completed
Waste Tank Retrieval	not completed
Waste Tank Pretreatment	not completed
High-Level Waste Immobilization	not completed
Low-Level Waste Immobilization	not completed

Table 6-2. Applicability of Characterization Information to the Data Needs of the TWRS Program Elements. (2 pages)

Data Quality Objective	Applicability to Characterization of Tank 241-AP-105
Solid, Low-Level Waste Disposal	not completed
RCRA Part B Permit Application	not completed
Tank C-106 High-Heat Safety Issue	does not apply
Organic Layer Sampling of Tank C-103	does not apply
Tank C-103 Vapor and Gas Sampling	does not apply

[1]The sampling requirement for the Safety Screening Data Quality Objective (Babad, 1994) calls for both vertical waste samples and a vapor space sample. The sampling and analysis of Tank 241-AP-105 supports full characterization of the waste in the tank; vapor space sampling or characterization was not conducted as part of this activity.

applies - The data needs expressed in this Data Quality Objectives document are fulfilled through this characterization report.

does not apply - The data needs expressed in this Data Quality Objectives document do not apply to the waste in Tank 241-AP-105.

not addressed - The data needs expressed in this Data Quality Objectives document were not addressed by this characterization report.

not complete - At the date of preparation of this report, this Data Quality Objectives document has not yet been completed.

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7.0 STATISTICAL INTERPRETATION

7.1 MASS AND CHARGE BALANCE

The principle objective for performing a mass and charge balance is to determine if the measurements are self-consistent. The mass and charge balance calculations also provide a method for estimating the weight percent of water. In calculating the balances, only analytes detected at a concentration of 1 ppm or greater were considered.

Mass and charge balance results are reported in Table 7-1. Although several of the cations listed in Table 7-1 actually exist in the form of oxo or hydroxo anions in solution, only their positive contribution to the net charge of the waste solution was taken into account. The hydroxide value obtained from the laboratory analyses was assumed to compensate for any negative charge neglected by this treatment of the data. Despite the above assumptions, a calculated charge imbalance resulted due to a shortage of positively charged ions. The approximate error from this discrepancy, however, was less than 3% and was not considered to adversely affect the mass balance. The mass concentration, µg/g, resulting from the sum of the cations and anions was subtracted from a million in order to obtain an estimated value for the weight percent of water. In other words, mass not accountable to the analyte concentrations is attributed to water. Inspection of the table demonstrates that the predicted weight percent of water in Tank 241-AP-105 is 59.6%. This agrees very closely to the analytical result of 60.6%.

Table 7-1. Tank 241-AP-105 Mass/Charge Balance. (2 pages)

	Mass µg/g	**Charge µmol/g**
Cations		
Beryllium (Be^{+2})	1.10	0.244
Cadmium (Cd^{+2})	1.33	0.0237
Calcium (Ca^{+2})	50.0	2.50
Chromium (Cr^{+6})	140	16.2
Iron (Fe^{+3})	4.95	0.266
Lead (Pb^{+2})	4.04	0.0390
Magnesium (Mg^{+2})	6.82	0.561
Nickel (Ni^{+2})	8.18	0.279
Potassium (K^{+1})	23,300	596
Sodium (Na^{+1})	125,000	5,430
Uranium (U^{+6})	31.7	0.799
Zinc (Zn^{+2})	44.1	1.35

Table 7-1. Tank 241-AP-105 Mass/Charge Balance. (2 pages)

	Mass μg/g	**Charge μmol/g**
Anions		
Tetrahydroxoaluminate [$Al(OH)_4^-$]	31,000	325
Tetraborate ($B_4O_7^{-2}$)	231	2.98
Chloride (Cl^-)	1,770	49.9
Cyanide (CN^-)	13.7	0.527
Fluoride (F^-)	1,140	60.0
Hydroxide (OH^-)	40,500	2,380
Nitrate (NO_3^-)	124,000	2,000
Nitrite (NO_2^-)	36,200	787
Phosphate (PO_4^{-3})	330	10.4
Metasilicate (SiO_3^{-2})	295	7.76
Sulfate (SO_4^{-2})	1,820	37.9
TIC-Carbonate (CO_3^{-2})	16,800	560
Totals		
Cations	149,000	6,050
Anions	254,000	6,220
Water (est.)	596,000 or 59.6 wt.%	

7.2 TANK HOMOGENEITY

The homogeneity of the waste in Tank 241-AP-105 was evaluated using the analysis of variance (ANOVA). The ANOVA analyzes the total variability of the analytical data, which consists of three components; the variability due to the analytical method, the variability due to different bottles (local homogeneity), and the variability between locations (tank homogeneity) (Welsh, 1994). The majority of the results using the ANOVA method indicated that the tank wastes were homogeneous. However, inspection of the data reveals that most analytes exhibited a noticeable trend of either increasing or decreasing concentration with tank depth. The failure of the ANOVA model to predict waste heterogeneity is attributed to the small number of degrees of freedom associated with the analysis. This means that the difference between locations has to be large before the ANOVA indicates that any difference is significant. A one-way ANOVA was performed in which the variability due to different bottles was eliminated. The results indicated that significant differences between means reported from different sample locations existed for the majority of species, including all radionuclides but ^{14}C. This majority included the five most prevalent analytes in Tank 241-AP-105, which are in descending order: sodium, potassium, aluminum, phosphorous and nitrate (minus two outlying data points). Of these five species, all but phosphorous increased in concentration with increasing tank depth. Phosphorous behaves in the opposite manner, decreasing in concentration with increasing tank depth. The concentration of ^{137}Cs, the most abundant radionuclide, increases with increasing tank depth. Additionally, the specific gravity (SpG) of the waste in Tank 241-AP-105 increases with tank depth while the percent water decreases with increasing tank depth. The SpG ranges from an average of 1.299 from the samples closest to the waste surface (approximately 15 inches below the surface) to 1.389 at the location 17 inches from the bottom of the tank. The percent water decreases from an average of 64.1 wt.% at the uppermost sample location to 55.1 wt.% at the bottom-most location. The trends of these species suggest that the waste is not homogeneous but rather varies with vertical position. This is consistent with the expectation of the waste to be heterogeneous. The increase in concentration of nonvolatile species would be expected since the lower portion of waste is concentrated slurry feed from the evaporator. Higher concentrations of species not present in the slurry feed and volatile components would be expected in the upper portion, which is from a transfer of dilute non-complexed waste from Tank 241-AP-106. Sulfate, ammonia, carbonate, aluminum, and ^{90}Sr were present in higher concentrations in Tank 241-AP-106 than in the slurry feed; thus, their concentrations are expected to be greater in the upper portion of Tank 241-AP-105.

The ANOVA indicated some significant differences in analyte concentrations relative to location. To further investigate the issue of tank homogeneity, and to determine if two discrete layers existed, a multiple comparison test was utilized in conjunction with the ANOVA. Tukey's Honestly Significant Difference (HSD) was performed on the analytical data to determine specifically which analytes showed significant difference by sample location. For a majority of analytes, the results indicated that the means reported from the three samples closest to the surface of the waste were significantly different from the means reported from the three samples closest to the bottom of the tank. However, the results also indicated that no distinct division in tank height at which the composition changes exists; therefore, no discrete layers exist (Welsh, 1994).

Table 7-2 lists the three of the most abundant chemical analytes, the most abundant radiochemical constituent, the specific gravity, and the percent water mean values reported at each sample location (Welsh, 1994). As can be observed from the table, no sharp division or stratification exists. Rather a gradual increase in concentration and density occurs with increasing tank depth while the opposite is true for percent water.

The historical estimate for the two layers of waste approximates the specific gravity and percent water of the upper layer as 1.25 and 70 wt.% and the lower layer as 1.42 and 53 wt.%. As can be seen from Table 7-2, the analytical data for both the specific gravity and percent water range between these values. Although the waste is not sharply divided into layers, the historical estimate values act as upper and lower bounds between which there is a gradual transition. The values estimated for ^{137}Cs in the two layers; 175,000 and 370,000 μCi/L in the upper and lower layers respectively, again act as bounding limits. This is also true for sodium. The analytical potassium values exhibit the opposite trend as the historical estimates. A possible explanation for this unexpected behavior is that the lower layer potassium value is derived from one sample and is qualified in the source document (Hendrickson & Welsh, 1992) as estimated with error no greater than 150%. The analytical values observed in the tank easily fall into this error range.

Table 7-2. Concentration Gradients in Tank 241-AP-105 (Welsh, 1994).

	Sodium	Potassium	Aluminum	SpG	H_2O %	^{137}Cs
Analytical Results						
General Trend	increase with depth	increase with depth	increase with depth	increase with depth	decrease with depth	increase with depth
inches from bottom of tank	Concentration in g/L			g/mL	--	μCi/L
285	146	28.3	9.76	1.298	64.6	195,000
285	149	29	9.93	1.300	63.6	195,000
277	150	30	10.5	1.298	64.5	194,000
258	149	29.9	9.72	1.300	64.3	194,000
221	162	30.8	11.6	1.327	61.3	222,000
203	165	29.5	11.3	1.341	60.1	233,000
180	167	30.5	11.9	1.338	60.3	232,000
147	169	31.4	12.3	1.335	60.1	235,000
133	171	31.6	12.4	1.338	60.1	232,000
115	162	29.1	11.1	1.344	59.5	232,000
65	190	37	13.7	1.377	55.4	266,000
42	174	33	11.9	1.348	59.3	236,000
17	193	30.2	14	1.389	55.1	255,000
Historical Estimate						
upper layer	64.4	28.2	7.55	1.25	70.0	170,000
lower layer	207	18.4	1.92	1.42	53.0	370,000

Several of the less prevalent analytes decrease in concentration as tank depth increases. As previously mentioned, some species are expected to be higher in the upper portion of the waste and decrease with increasing tank depth. However, aluminum behaves unexpectedly and is found in higher concentrations in the lower portion of the waste. This could be due to several causes. First, the value of aluminum in the double-shell slurry feed may have been underestimated. Secondly, the aluminum may have formed a precipitate or heavier complexed ion which has settled in the years since tank activity. The data validation package from PNL (St. Denis, 1993) reported a solid present in sample numbers G-238 and G-239. Both samples are from the bottom most location, located 17 inches from the bottom of the tank. Therefore, it is possible that some precipitate has formed and settled to the bottom of the tank. This is not completely unexpected as double-shell slurrfy feed wastes often contain sludges, crystals, crusts, and flocculants.

7.3 ANALYTICAL ERROR ESTIMATION

Analytical error consists of two components, random and systematic. Table 7-3 outlines both the analytical and systematic error estimates, organized by analyte. Error estimates were not done for analytes with "less than" (non-detected) values.

Random Analytical Error

The random analytical error can be estimated from the analytical results of the duplicate samples, or from the analysis of standards. However, the analysis of standards does not account for all the sources of variability, such as matrix interferences.

The relative percent difference (RPD) or relative standard deviation (RSD) values for random analytical error are listed in Table 7-3. Although the values based on sample results for Ni, SpG, and $^{239/240}Pu$ appear low, each had 1 duplicate sample with an RPD or RSD over the criterion of three times the random analytical error from sample results, and P had two sample pairs over the limit. Still, the low RPD/RSD's indicate generally good experimental results. All data for Fe and Pb were below the RPD/RSD criterion, but moderate variation in the individual sample means led to a larger random analytical error. While the random analytical estimates appear high for Cl^-, NO_2^-, NO_3^-, PO_4^- , SO_4^{-2}, and ^{129}I, they all actually fall below their respective RPD/RSD criterion. The problem with ^3H was mirrored in the poor spike recoveries. The analytical methodology for ^3H employing distillation techniques to recover tritiated water vapor did not perform well for these samples, leading to questionable results.

Systematic Analytical Error

The systematic error estimate is determined from the analysis of standards or spike recoveries. As can be seen in Table 7-3, there are noticeable differences in the two estimates for some of the analytes; however, the only analytes with one or more spike recoveries outside the specified limits of 100% $\pm$ 25% were Cr (both spikes outside the limits), F^- and SO^{-2}_4 (each with one outside the limits), and ^3H (all three outside the limits). This indicates that for most analytes, matrix interference was minimal.

Table 7-3. Measurement Error Estimates Tank 241-AP-105 (Welsh, 1994). (3 pages)

Analyte	Random Analytical Error Estimate 1 RSD (%)		Systematic Error Estimate 1 RSD (%)	
	From Sample Results	From Standard Results	From Standard Results*	From Spike Analysis
Al	3.0	4.6	5.1	NA
Sb	NA	5.0	1.4	8.6
Ba	6.5	2.1	2.1	8.0
Be	3.4	3.7	0.9	12.2
Cd	5.4	3.5	1.6	12.1
Cr	2.5	3.4	0.5	32.6
Fe	21.9	2.3	1.3	15.7
Pb	21.4	4.1	1.2	5.4

Table 7-3. Measurement Error Estimates Tank 241-AP-105 (Welsh, 1994). (3 pages)

Analyte	Random Analytical Error Estimate 1 RSD (%)		Systematic Error Estimate 1 RSD (%)	
	From Sample Results	From Standard Results	From Standard Results*	From Spike Analysis
Ni	7.7	3.0	1.1	8.8
K	2.9	3.8	1.4	NA
Ag	NA	2.8	2.5	4.2
Na	2.7	2.2	2.3	NA
P	5.1	3.7	0.6	17.1
^{137}Cs	0.7	5.1	2.7	NA
^{134}Cs	4.8	NA	NA	NA
^{60}Co	NA	3.5	0.9	NA
F^-	NA	6.1	3.0	15.5
Cl^-	39.1	4.6	0.2	1.7
NO_2^-	24.3	3.8	1.5	1.2
NO_3^-	25.2	4.6	0.3	3.2
PO_4^{-3}	62.0	4.0	0.4	21.5
SO_4^{-2}	60.2	3.7	3.9	25.1
% Water	0.2	1.2	0.8	NA
SpG	0.4	0.6	1.2	NA
TIC	16.9	3.5	0.8	3.1
TOC	8.8	3.0	4.0	4.0
$^{239/240}Pu$	8.5	6.5	1.3	NA
^{14}C	20.7	3.7	15.6	9.1
^{99}Tc	7.2	8.6	3.4	NA
^{237}Np	NA	17.9	18.8	NA
^{241}Am	18.0	13.6	3.0	NA
Se	11.7	7.7	2.3	16.9
^{90}Sr	7.1	8.1	4.3	NA
^{129}I	23.7	15.0	10.4	NA
OH^-	2.5	2.0	0.5	NA
CN^-	4.2	2.3	3.7	5.6
U	17.5	7.3	1.1	3.3
As	16.3	6.9	9.8	NA
Hg	NA	8.3	11.5	NA

Table 7-3. Measurement Error Estimates Tank 241-AP-105 (Welsh, 1994). (3 pages)

Analyte	Random Analytical Error Estimate 1 RSD (%)		Systematic Error Estimate 1 RSD (%)	
	From Sample Results	From Standard Results	From Standard Results*	From Spike Analysis
NH_3/NH_4^+	NA	7.5	1.8	6.6
^3H	87.2	5.2	7.8	247.8
EDTA	6.9	NA	NA	16.3
HEDTA	16.6	NA	NA	4.6
Citrate	15.4	NA	NA	2.1
Oxalate	20.2	NA	NA	5.0
Glycolate	10.9	NA	NA	22.5

* Calculated from the Laboratory Measurement Control System standards analyzed in conjunction with the samples

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8.0 CONCLUSION AND RECOMMENDATIONS

8.1 SAFETY ISSUES

Characterization of Tank 241-AP-105 supports the classification of the tank as non-Watch List. Given the current tank inventory of fissionable radionuclides and organic or exothermic waste constituents, no credible potential exists for loss of tank integrity or release of radioactivity due to in-tank processes. Tank 241-AP-105 is within established operating safety requirements as defined by applicable Data Quality Objectives.

Tank 241-AP-105 is considered sound and non-leaking (Hanlon, 1994), and examination of the waste volume history supports this conclusion (Koreski, 1994). Thermocouple data indicate that while tank temperatures are elevated above ambient soil temperatures, there is no credible risk of self-boiling or excessive heating of the current tank contents. Given the present tank integrity and waste properties, continued active operation of Tank 241-AP-105 for waste management and storage functions poses no unreasonable risk to personnel, the public, or the environment.

8.2 FURTHER CHARACTERIZATION NEEDS

Characterization of the liquid contents of Tank 241-AP-105 has been performed in this report; however, the following studies which may involve further sampling and analysis are recommended:

- An analysis of the tank vapor space would allow final resolution of any safety concerns regarding the presence of flammable or noxious fumes.
- Rheological properties of the waste need to be determined before retrieval and transfer operations are conducted.
- A layer of precipitated solids may presently exist or could potentially develop on the floor of the tank; therefore, it may be necessary to characterize the very bottom of the tank. Further precipitation studies may also be necessary.
- The installation of a mixing pump may expedite retrieval operations.

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APPENDIX A

ANALYTICAL RESULTS

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A.1 Introduction

A.1.1 Appendix A presents the chemical and radiological characteristics of tank 241-AP-105 in a tabular form, in terms of the specific concentrations of anions, metals, radionuclides, and physical characteristics.

The data table for each analyte lists laboratory sample identification, analytical result, range of results, an evaluated data result, and a projected tank inventory for the particular analyte. The projected tank inventory column is not applicable for the specific gravity data. The data are listed in standard notation for values >.001 and <100,000; values outside these limits are listed in scientific notation.

A.2 Table Description

A.2.1 Abbreviations

Standard abbreviations are used to describe analytical methods.

Metals:

ICP - Inductively Coupled Plasma (generic for all metals unless otherwise known)

CVAA - Cold Vapor Atomic Absorption

AAS - Atomic Absorption Spectroscopy

Anions:

IC - Ion Chromatography

Radionuclides:

GEA - Gamma Energy Analysis

AEA - Alpha Energy Analysis

APC - Alpha Proportional Counting

BPC - Beta Proportional Counting

LSC - Liquid Scintillation Counting

Physical Properties:

PT - Physical Testing

DM - Direct Measurement

DSC - Differential Scanning Calorimetry

TGA - Thermogravimetric Analysis

A.3 Column Headings

A.3.1 The 'Analyte' column contains, in addition to the name of the analyte or physical characteristic, information about the method of measurement.

The analyte and method are presented as follows: 'method.analyte'. For example, the specific concentration of ^{90}Sr was measured with a beta proportional counter and is listed 'BPC.^{90}Sr'. The specific concentration of Pb was determined by the inductively coupled plasma method which is listed as 'ICP.Pb'.

A.3.2 The 'Laboratory Sample Identification' column lists the samples for which the analyte was measured. The 'Sampling Identification Number' is different from the number assigned to the samples at the tank farm. Sampling rationale, locations, and descriptions of sampling events are contained in Section 3.0.

A.3.3 'Analytical Data Result' is the specific concentration of the analyte determined at different sampling points. No quality control data such as matrix spikes, serial dilutions, or duplicate analyses are listed. Data which have been evaluated as unusable are denoted by a strikeout, i.e., ~~1000~~.

A.3.4 The 'Range of Values' column lists the highest and the lowest values for a particular analyte. If a measurement method has a constant method detection limit, and all results are less than the MDL, no range is given. However, if the MDL changes, i.e., due to radiation background variations in radiochemistry, a range of detection limit values is given.

A.3.5 Column 5 'Evaluated Data Result' was derived as discussed in Section 5.0.

A.3.6 Column 6, 'Projected Inventory', is the product of the concentration of the analyte and the volume of the waste in the tank. (3.11E+06 Liters).

LIST OF TABLES FOR APPENDIX A

LIST OF TABLES FOR APPENDIX A (continued)

Table A-1. Tank 241-AP-105 Analytical Data: Aluminum

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Al	Sample G409	1.05E+07	9.72E+06 to 1.40E+07	1.17E+07	3.67E+05	36,400
	Sample G407	1.19E+07				
	Sample G402	1.24E+07				
	Sample G401	1.40E+07				
	Sample G418	9.72E+06				
	Sample G417	1.16E+07				
	Sample G413	1.23E+07				
	Sample G412	1.37E+07				
	Sample G396	9.76E+06				
	Sample G397	9.93E+06				
	Sample G392	1.13E+07				
	Sample G391	1.11E+07				
	Sample G422	1.19E+07				
	Composite Sample G378	1.16E+07				
	Composite Sample G379	1.15E+07				

Table A-1. Tank 241-AP-105 Analytical Data: Antimony

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Sb	Sample G409	< 12,900	< 5,250 to < 2.63E+05	6,760	N/A	21.0
	Sample G407	< 12,900				
	Sample G402	< 5,250				
	Sample G401	< 5,610				
	Sample G418	< 5,250				
	Sample G417	< 263,000				
	Sample G413	< 5,250				
	Sample G412	6,760				
	Sample G396	< 5,250				
	Sample G397	< 5,250				
	Sample G392	< 5,250				
	Sample G391	< 5,250				
	Sample G422	< 210,000				
	Composite Sample G378	< 5,250				
	Composite Sample G379	< 5,250				

Table A-1. Tank 241-AP-105 Analytical Data: Arsenic

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Metal		µg/mL	µg/mL	µg/mL	µg/mL	kg
AAS.As	Composite Sample G378	1.03	0.787 to 1.03	0.909	N/A	2.83
	Composite Sample G379	0.787				

Table A-1. Tank 241-AP-105 Analytical Data: Barium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Ba	Sample G409	1,450	465 to 1,450	638	88.1	1.98
	Sample G407	747				
	Sample G402	508				
	Sample G401	465				
	Sample G418	532				
	Sample G417	~~< 3,750~~				
	Sample G413	535				
	Sample G412	544				
	Sample G396	482				
	Sample G397	597				
	Sample G392	540				
	Sample G391	523				
	Sample G422	~~< 3,000~~				
	Composite Sample G378	516				
	Composite Sample G379	547				

Table A-1. Tank 241-AP-105 Analytical Data: Beryllium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		μg/L	μg/L	μg/L	μg/L	kg
ICP.Be	Sample G409	1,400	1,220 to 1,680	1,460	47.6	4.54
	Sample G407	1,620				
	Sample G402	1,510				
	Sample G401	1,680				
	Sample G418	1,230				
	Sample G417	~~< 3,750~~				
	Sample G413	1,440				
	Sample G412	1,620				
	Sample G396	1,170				
	Sample G397	1,220				
	Sample G392	1,470				
	Sample G391	1,460				
	Sample G422	~~< 3,000~~				
	Composite Sample G378	1,470				
	Composite Sample G379	1,530				

Table A-1. Tank 241-AP-105 Analytical Data: Cadmium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Cd	Sample G409	1,960	1,620 to 2,050	1,770	41.3	5.50
	Sample G407	1,810				
	Sample G402	1,750				
	Sample G401	1,730				
	Sample G418	1,870				
	Sample G417	~~< 7,500~~				
	Sample G413	1,750				
	Sample G412	1,700				
	Sample G396	1,780				
	Sample G397	1,970				
	Sample G392	1,620				
	Sample G391	1,640				
	Sample G422	~~< 6,030~~				
	Composite Sample G378	1,990				
	Composite Sample G379	2,050				

Table A-1. Tank 241-AP-105 Analytical Data: Chromium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		μg/L	μg/L	μg/L	μg/L	kg
ICP.Cr	Sample G409	1.76E+05	1.45E+05 to 2.19E+05	1.87E+05	5,460	582
	Sample G407	1.97E+05				
	Sample G402	1.94E+05				
	Sample G401	2.19E+05				
	Sample G418	1.60E+05				
	Sample G417	1.99E+05				
	Sample G413	1.87E+05				
	Sample G412	2.07E+05				
	Sample G396	1.45E+05				
	Sample G397	1.54E+05				
	Sample G392	1.80E+05				
	Sample G391	1.79E+05				
	Sample G422	1.97E+05				
	Composite Sample G378	1.94E+05				
	Composite Sample G379	1.96E+05				

Table A-1. Tank 241-AP-105 Analytical Data: Iron

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Fe	Sample G409	7,230	4,980 to 9,670	6,600	418	20.5
	Sample G407	5,790				
	Sample G402	4,980				
	Sample G401	6,480				
	Sample G418	6,230				
	Sample G417	~~< 19,200~~				
	Sample G413	5,490				
	Sample G412	8,980				
	Sample G396	6,600				
	Sample G397	9,670				
	Sample G392	6,100				
	Sample G391	6,570				
	Sample G422	~~< 15,000~~				
	Composite Sample G378	6,040				
	Composite Sample G379	6,230				

Table A-1. Tank 241-AP-105 Analytical Data: Lead

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		μg/L	μg/L	μg/L	μg/L	kg
ICP.Pb	Sample G409	7,620	4,190 to 7,620	5,390	292	16.8
	Sample G407	6,610				
	Sample G402	5,500				
	Sample G401	5,340				
	Sample G418	4,190				
	Sample G417	~~< 77,500~~				
	Sample G413	4,780				
	Sample G412	5,580				
	Sample G396	5,260				
	Sample G397	5,660				
	Sample G392	4,760				
	Sample G391	5,290				
	Sample G422	~~< 62,000~~				
	Composite Sample G378	4,510				
	Composite Sample G379	5,020				

Table A-1. Tank 241-AP-105 Analytical Data: Mercury

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Metal		μg/mL	μg/mL	μg/mL	μg/mL	kg
CVAA.Hg	Composite Sample G378	< 0.025	< 0.010 to < 0.025	< 0.025	N/A	< 0.078
	Composite Sample G379	< 0.010				

Table A-1. Tank 241-AP-105 Analytical Data: Nickel

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		μg/L	μg/L	μg/L	μg/L	kg
ICP.Ni	Sample G409	10,500	8,990 to 12,300	10,900	306	33.8
	Sample G407	12,000				
	Sample G402	11,200				
	Sample G401	12,300				
	Sample G418	9,610				
	Sample G417	~~< 16,300~~				
	Sample G413	10,900				
	Sample G412	11,900				
	Sample G396	8,990				
	Sample G397	9,700				
	Sample G392	10,800				
	Sample G391	11,000				
	Sample G422	~~< 15,400~~				
	Composite Sample G378	11,000				
	Composite Sample G379	11,400				

Table A-1. Tank 241-AP-105 Analytical Data: Phosphorus

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.P	Sample G409	4.59E+05	2.11E+05 to 4.59E+05	3.16E+05	19,900	983
	Sample G407	3.15E+05				
	Sample G402	2.95E+05				
	Sample G401	2.99E+05				
	Sample G418	3.90E+05				
	Sample G417	2.22E+05				
	Sample G413	2.98E+05				
	Sample G412	3.14E+05				
	Sample G396	3.85E+05				
	Sample G397	4.26E+05				
	Sample G392	3.05E+05				
	Sample G391	2.83E+05				
	Sample G422	2.11E+05				
	Composite Sample G378	3.36E+05				
	Composite Sample G379	3.47E+05				

Table A-1. Tank 241-AP-105 Analytical Data: Potassium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.K	Sample G409	3.00E+07	2.83E+07 to 3.31E+07	3.10E+07	6.44E+05	96,400
	Sample G407	3.05E+07				
	Sample G402	3.16E+07				
	Sample G401	3.02E+07				
	Sample G418	2.99E+07				
	Sample G417	3.08E+07				
	Sample G413	3.14E+07				
	Sample G412	3.70E+07				
	Sample G396	2.83E+07				
	Sample G397	2.90E+07				
	Sample G392	2.95E+07				
	Sample G391	2.91E+07				
	Sample G422	3.30E+07				
	Composite Sample G378	3.31E+07				
	Composite Sample G379	3.29E+07				

Table A-1. Tank 241-AP-105 Analytical Data: Selenium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		μg/mL	μg/mL	μg/mL	μg/mL	kg
AAS.Se	Sample G409	0.143	0.117 to < 0.250	0.141	0.00666	0.439
	Sample G407	0.122				
	Sample G402	0.126				
	Sample G401	0.159				
	Sample G418	0.136				
	Sample G417	0.132				
	Sample G413	0.161				
	Sample G412	0.195				
	Sample G396	0.161				
	Sample G397	0.160				
	Sample G392	0.117				
	Sample G391	0.128				
	Sample G422	0.119				
	Composite Sample G378	< 0.250				
	Composite Sample G379	< 0.250				

Table A-1. Tank 241-AP-105 Analytical Data: Silver

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Metal		μg/L	μg/L	μg/L	μg/L	kg
ICP.Ag	Sample G409	< 600	< 125 to < 6,250	139	13.3	0.432
	Sample G407	< 600				
	Sample G402	154				
	Sample G401	131				
	Sample G418	< 125				
	Sample G417	< 6,250				
	Sample G413	< 125				
	Sample G412	< 125				
	Sample G396	< 125				
	Sample G397	131				
	Sample G392	< 125				
	Sample G391	< 125				
	Sample G422	< 5,000				
	Composite Sample G378	< 125				
	Composite Sample G379	< 125				

Table A-1. Tank 241-AP-105 Analytical Data: Sodium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Metal		µg/L	µg/L	µg/L	µg/L	kg
ICP.Na	Sample G409	1.50E+08	1.46E+08 to 1.93E+08	1.67E+08	4.02E+06	5.19E+05
	Sample G407	1.67E+08				
	Sample G402	1.71E+08				
	Sample G401	1.93E+08				
	Sample G418	1.49E+08				
	Sample G417	1.62E+08				
	Sample G413	1.69E+08				
	Sample G412	1.90E+08				
	Sample G396	1.46E+08				
	Sample G397	1.49E+08				
	Sample G392	1.65E+08				
	Sample G391	1.62E+08				
	Sample G422	1.74E+08				
	Composite Sample G378	1.72E+08				
	Composite Sample G379	1.71E+08				

Table A-1. Tank 241-AP-105 Analytical Data: Uranium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Metal		μg/mL	μg/mL	μg/mL	μg/mL	kg
LF.U	Composite Sample G378	35.8	35.8 to 48.6	42.2	N/A	131
	Composite Sample G379	48.6				

Table A-2. Tank 241-AP-105 Analytical Data: Ammonia

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Cation		μg/mL	μg/mL	μg/mL	μg/mL	kg
POT.AUTO TIT. NH_3	Composite Sample G378	< 40.0	N/A	< 40.0	N/A	< 124
	Composite Sample G379	< 40.0				

Table A-2. Tank 241-AP-105 Analytical Data: Chloride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Anion		μg/mL	μg/mL	μg/mL	μg/mL	kg
IC.Cl^-	Sample G409	2,280	1,970 to 3,180	2,360	133	7,340
	Sample G407	2,400				
	Sample G402	3,180				
	Sample G401	3,020				
	Sample G418	1,800				
	Sample G417	1,970				
	Sample G413	2,260				
	Sample G412	2,400				
	Sample G396	1,970				
	Sample G397	1,860				
	Sample G392	2,640				
	Sample G391	2,180				
	Sample G422	2,290				
	Composite Sample G378	2,650				
	Composite Sample G379	2,690				

Table A-2. Tank 241-AP-105 Analytical Data: Cyanide

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Anion		μg/mL	μg/mL	μg/mL	μg/mL	kg
SPECTRO-PHOTO. CN^-	Composite Sample G378	18.9	17.7 to 18.9	18.3	N/A	56.9
	Composite Sample G379	17.7				

Table A-2. Tank 241-AP-105 Analytical Data: Fluoride

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.F^-	Sample G409	~~< 10.1~~	N/A	N/A	N/A	N/A
	Sample G407	~~< 209~~				
	Sample G402	~~< 5.10~~				
	Sample G401	~~< 10.1~~				
	Sample G418	~~< 168~~				
	Sample G417	~~1,400~~				
	Sample G413	~~850~~				
	Sample G412	~~657~~				
	Sample G396	~~4,491~~				
	Sample G397	~~< 40.1~~				
	Sample G392	~~< 40.1~~				
	Sample G391	~~< 40.1~~				
	Sample G422	~~659~~				
	Composite Sample G378	~~< 10.1~~				
	Composite Sample G379	~~< 10.1~~				
ISE.F^-	Sample P1530	1,520	N/A	1,520	N/A	4,730

Table A-2. Tank 241-AP-105 Analytical Data: Hydroxide

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	µg/mL	kg
AUTOTIT. OH^-	Composite Sample G378	54,800	53,100 to 54,800	54,000	N/A	1.68E+05
	Composite Sample G379	53,100				

Table A-2. Tank 241-AP-105 Analytical Data: Nitrate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Anion		µg/mL	µg/mL	µg/mL	µg/mL	kg
IC.NO_3^-	Sample G409	1.72E+05	1.03E+05 to 2.36E+05	1.65E+05	7,150	5.13E+05
	Sample G407	1.68E+05				
	Sample G402	1.71E+05				
	Sample G401	2.21E+05				
	Sample G418	1.03E+05				
	Sample G417	1.61E+05				
	Sample G413	1.67E+05				
	Sample G412	1.94E+05				
	Sample G396	2.36E+05				
	Sample G397	1.38E+05				
	Sample G392	1.52E+05				
	Sample G391	1.58E+05				
	Sample G422	1.60E+05				
	Composite Sample G378	1.70E+05				
	Composite Sample G379	1.70E+05				

Table A-2. Tank 241-AP-105 Analytical Data: Nitrite

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Anion		μg/mL	μg/mL	μg/mL	μg/mL	kg
IC.NO_2^-	Sample G409	44,900	40,100 to 58,500	48,300	1,480	1.50E+05
	Sample G407	53,500				
	Sample G402	49,900				
	Sample G401	58,500				
	Sample G418	40,100				
	Sample G417	46,200				
	Sample G413	48,800				
	Sample G412	50,500				
	Sample G396	42,100				
	Sample G397	44,200				
	Sample G392	48,400				
	Sample G391	50,000				
	Sample G422	45,700				
	Composite Sample G378	48,800				
	Composite Sample G379	49,000				

Table A-2. Tank 241-AP-105 Analytical Data: Phosphate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Anion		μg/mL	μg/mL	μg/mL	μg/mL	kg
IC.PO_4^{3-}	Sample G409	476	300 to 2,360	440	35.6	1,370
	Sample G407	324				
	Sample G402	347				
	Sample G401	414				
	Sample G418	598				
	Sample G417	< 861				
	Sample G413	423				
	Sample G412	350				
	Sample G396	548				
	Sample G397	622				
	Sample G392	< 401				
	Sample G391	< 401				
	Sample G422	458				
	Composite Sample G378	301				
	Composite Sample G379	300				

Table A-2. Tank 241-AP-105 Analytical Data: Sulfate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Anion		μg/mL	μg/mL	μg/mL	μg/mL	kg
IC.SO_4^{2-}	Sample G409	4,050	1,130 to 4,050	2,420	292	7,530
	Sample G407	4,040				
	Sample G402	1,520				
	Sample G401	1,130				
	Sample G418	3,390				
	Sample G417	2,200				
	Sample G413	1,970				
	Sample G412	1,270				
	Sample G396	2,750				
	Sample G397	3,130				
	Sample G392	1,770				
	Sample G391	1,680				
	Sample G422	1,590				
	Composite Sample G378	3,240				
	Composite Sample G379	1,970				

Table A-3. Tank 241-AP-105 Analytical Data: Americium-241

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
AEA.^{241}Am	Sample G409	4.24E-04	3.02E-04 to 6.03E-04	4.08E-04	2.28E-05	1.27
	Sample G407	3.94E-04				
	Sample G402	3.85E-04				
	Sample G401	6.02E-04				
	Sample G418	4.46E-04				
	Sample G417	4.13E-04				
	Sample G413	3.50E-04				
	Sample G412	4.05E-04				
	Sample G396	3.65E-04				
	Sample G397	3.76E-04				
	Sample G392	4.29E-04				
	Sample G391	3.84E-04				
	Sample G422	3.02E-04				
	Composite Sample G378	3.48E-04				
	Composite Sample G379	4.15E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Antimony-125

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{125}Sb	Sample G409	< 0.388	< 0.290 to < 0.699	< 0.699	N/A	< 2,170
	Sample G407	< 0.425				
	Sample G402	< 0.296				
	Sample G401	< 0.312				
	Sample G418	< 0.385				
	Sample G417	< 0.290				
	Sample G413	< 0.427				
	Sample G412	< 0.455				
	Sample G396	< 0.699				
	Sample G397	< 0.695				
	Sample G392	< 0.298				
	Sample G391	< 0.297				
	Sample G422	< 0.300				
	Composite Sample G378	< 0.416				
	Composite Sample G379	< 0.417				

Table A-3. Tank 241-AP-105 Analytical Data: Carbon-14

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
LSC.^{14}C	Sample G409	2.06E-04	1.92E-04 to 3.03E-04	2.17E-04	9.97E-06	0.675
	Sample G407	2.01E-04				
	Sample G402	3.03E-04				
	Sample G401	2.41E-04				
	Sample G418	2.19E-04				
	Sample G417	2.10E-04				
	Sample G413	2.14E-04				
	Sample G412	2.09E-04				
	Sample G396	2.03E-04				
	Sample G397	2.13E-04				
	Sample G392	1.96E-04				
	Sample G391	1.92E-04				
	Sample G422	2.18E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Cerium/Praeseodymium-144

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA. ^{144}Ce/Pr	Sample G409	< 0.926	< 0.530 to < 1.30	< 1.30	N/A	< 4,040
	Sample G407	< 1.02				
	Sample G402	< 0.543				
	Sample G401	< 0.568				
	Sample G418	< 0.942				
	Sample G417	< 0.530				
	Sample G413	< 1.02				
	Sample G412	< 1.08				
	Sample G396	< 1.29				
	Sample G397	< 1.30				
	Sample G392	< 0.545				
	Sample G391	< 0.545				
	Sample G422	< 0.544				
	Composite Sample G378	< 1.01				
	Composite Sample G379	< 0.998				

Table A-3. Tank 241-AP-105 Analytical Data: Cesium-134

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{134}Cs	Sample G409	0.424	0.422 to 0.612	0.522	0.0180	1,620
	Sample G407	0.552				
	Sample G402	0.534				
	Sample G401	0.596				
	Sample G418	0.430				
	Sample G417	0.496				
	Sample G413	0.536				
	Sample G412	0.612				
	Sample G396	0.422				
	Sample G397	0.430				
	Sample G392	0.552				
	Sample G391	0.550				
	Sample G422	0.564				
	Composite Sample G378	0.522				
	Composite Sample G379	0.490				

Table A-3. Tank 241-AP-105 Analytical Data: Cesium-137

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{137}Cs	Sample G409	194	194 to 266	227	6.33	7.06E+05
	Sample G407	232				
	Sample G402	232				
	Sample G401	255				
	Sample G418	194				
	Sample G417	222				
	Sample G413	235				
	Sample G412	266				
	Sample G396	195				
	Sample G397	195				
	Sample G392	233				
	Sample G391	232				
	Sample G422	236				
	Composite Sample G378	225				
	Composite Sample G379	226				

Table A-3. Tank 241-AP-105 Analytical Data: Cobalt-60

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
GEA.^{60}Co	Sample G409	< 0.0192	< 0.0112 to < 0.0433	< 0.0433	N/A	< 135
	Sample G407	< 0.0197				
	Sample G402	< 0.0112				
	Sample G401	< 0.0121				
	Sample G418	< 0.0175				
	Sample G417	< 0.0133				
	Sample G413	< 0.0186				
	Sample G412	< 0.0207				
	Sample G396	< 0.0405				
	Sample G397	< 0.0433				
	Sample G392	< 0.0136				
	Sample G391	< 0.0121				
	Sample G422	< 0.0125				
	Composite Sample G378	< 0.0169				
	Composite Sample G379	< 0.0150				

Table A-3. Tank 241-AP-105 Analytical Data: Curium-243/244

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
AEA.$^{243/244}$Cm	Sample G409	< 6.37E-04	< 3.44E-04 to < 6.37E-04	< 6.37E-04	N/A	< 1.98
	Sample G407	< 4.46E-04				
	Sample G402	< 6.37E-04				
	Sample G401	< 5.94E-04				
	Sample G418	< 4.27E-04				
	Sample G417	< 6.37E-04				
	Sample G413	< 3.50E-04				
	Sample G412	< 6.37E-04				
	Sample G396	< 3.44E-04				
	Sample G397	< 6.37E-04				
	Sample G392	< 6.37E-04				
	Sample G391	< 5.19E-04				
	Sample G422	< 6.37E-04				
	Composite Sample G378	< 6.37E-04				
	Composite Sample G379	< 6.37E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Iodine-129

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
GEA.^{129}I	Sample G409	1.13E-05	< 4.64E-05 to < 4.03E-04	1.52E-04	7.18E-05	0.473
	Sample G407	1.96E-04				
	Sample G402	1.31E-04				
	Sample G401	1.56E-04				
	Sample G418	1.22E-04				
	Sample G417	1.32E-04				
	Sample G413	5.07E-05				
	Sample G412	1.54E-04				
	Sample G396	< 4.64E-05				
	Sample G397	8.98E-05				
	Sample G392	< 4.03E-04				
	Sample G391	3.05E-04				
	Sample G422	1.69E-04				
	Composite Sample G378	1.63E-04				
	Composite Sample G379	1.89E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Neptunium-237

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
APC.^{237}Np	Sample G409	< 4.32E-04	< 3.35E-04 to < 4.64E-04	3.14E-04	N/A	0.977
	Sample G407	3.14E-04				
	Sample G402	< 3.89E-04				
	Sample G401	< 3.89E-04				
	Sample G418	< 3.89E-04				
	Sample G417	< 3.89E-04				
	Sample G413	< 4.32E-04				
	Sample G412	< 4.32E-04				
	Sample G396	< 3.35E-04				
	Sample G397	< 4.64E-04				
	Sample G392	< 4.32E-04				
	Sample G391	< 4.32E-04				
	Sample G422	< 4.31E-04				
	Composite Sample G378	< 4.32E-04				
	Composite Sample G379	< 3.89E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Niobium-94

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
GEA.^{94}Nb	Sample G409	< 0.0219	< 0.0155 to < 0.0457	< 0.0457	N/A	< 142
	Sample G407	< 0.0250				
	Sample G402	< 0.0162				
	Sample G401	< 0.0178				
	Sample G418	< 0.0201				
	Sample G417	< 0.0155				
	Sample G413	< 0.0247				
	Sample G412	< 0.0250				
	Sample G396	< 0.0457				
	Sample G397	< 0.0427				
	Sample G392	< 0.0160				
	Sample G391	< 0.0165				
	Sample G422	< 0.0160				
	Composite Sample G378	< 0.0235				
	Composite Sample G379	< 0.0236				

Table A-3. Tank 241-AP-105 Analytical Data: Plutonium-238

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
AEA.^{238}Pu	Sample G409	< 1.03E-04	< 8.89E-05 to < 8.98E-04	< 8.98E-04	N/A	< 2.79
	Sample G407	< 9.81E-05				
	Sample G402	< 7.28E-04				
	Sample G401	< 6.09E-04				
	Sample G418	< 8.89E-05				
	Sample G417	< 2.05E-04				
	Sample G413	< 8.98E-04				
	Sample G412	< 8.40E-04				
	Sample G396	< 2.50E-04				
	Sample G397	< 5.01E-04				
	Sample G392	< 1.01E-04				
	Sample G391	< 1.11E-04				
	Sample G422	< 2.52E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Plutonium-239/240

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
AEA.$^{239/240}$Pu	Sample G409	1.80E-04	< 1.14E-04 to 1.81E-04	1.58E-04	6.11E-06	0.491
	Sample G407	1.20E-04				
	Sample G402	1.61E-04				
	Sample G401	< 1.14E-04				
	Sample G418	1.71E-04				
	Sample G417	1.81E-04				
	Sample G413	1.61E-04				
	Sample G412	1.37E-04				
	Sample G396	1.59E-04				
	Sample G397	1.69E-04				
	Sample G392	1.59E-04				
	Sample G391	1.48E-04				
	Sample G422	1.60E-04				

Table A-3. Tank 241-AP-105 Analytical Data: Ruthenium/Rhodium-106

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Largest Detection Limit	Standard Deviation (Sample)	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
GEA.^{106}Ru/Rh	Sample G409	< 1.24	< 1.04 to < 2.40	< 2.40	N/A	< 7,470
	Sample G407	< 1.35				
	Sample G402	< 1.05				
	Sample G401	< 1.09				
	Sample G418	< 1.25				
	Sample G417	< 1.04				
	Sample G413	< 1.37				
	Sample G412	< 1.45				
	Sample G396	< 2.38				
	Sample G397	< 2.40				
	Sample G392	< 1.06				
	Sample G391	< 1.04				
	Sample G422	< 1.06				
	Composite Sample G378	< 1.35				
	Composite Sample G379	< 1.36				

Table A-3. Tank 241-AP-105 Analytical Data: Strontium-90

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		µCi/mL	µCi/mL	µCi/mL	µCi/mL	Ci
BPC.^{90}Sr	Sample G409	0.234	0.176 to 0.255	0.208	0.00809	647
	Sample G407	0.182				
	Sample G402	0.180				
	Sample G401	0.242				
	Sample G418	0.243				
	Sample G417	0.207				
	Sample G413	0.189				
	Sample G412	0.253				
	Sample G396	0.219				
	Sample G397	0.240				
	Sample G392	0.176				
	Sample G391	0.182				
	Sample G422	0.188				
	Composite Sample G378	0.208				
	Composite Sample G379	0.201				

Table A-3. Tank 241-AP-105 Analytical Data: Technetium-99

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
LSC.^{99}Tc	Sample G409	0.0597	0.0564 to 0.0860	0.0698	0.00250	217
	Sample G407	0.0739				
	Sample G402	0.0746				
	Sample G401	0.0860				
	Sample G418	0.0587				
	Sample G417	0.0647				
	Sample G413	0.0625				
	Sample G412	0.0794				
	Sample G396	0.0564				
	Sample G397	0.0611				
	Sample G392	0.0703				
	Sample G391	0.0746				
	Sample G422	0.0742				
	Composite Sample G378	0.0772				
	Composite Sample G379	0.0652				

Table A-3. Tank 241-AP-105 Analytical Data: Tritium

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Radionuclide		μCi/mL	μCi/mL	μCi/mL	μCi/mL	Ci
LSC.^{3}H	Composite Sample G378	0.00437	0.00337 to 0.00437	0.00387	N/A	12.0
	Composite Sample G379	0.00337				

Table A-4. Tank 241-AP-105 Analytical Data: EDTA

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Organic Complex		mg/L	mg/L	mg/L	mg/L	kg
HPLC.EDTA	Sample G239	148	91 to 148	124	21.6	385
	Sample G242	131				
	Sample G246	124				
	Sample G247	139				
	Sample G252	136				
	Sample G270	97				
	Sample G255	91				

Table A-4. Tank 241-AP-105 Analytical Data: HEDTA

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Organic Complex		mg/L	mg/L	mg/L	mg/L	kg
HPLC.HEDTA	Sample G239	23	5 to 23	15.9	7.58	49.3
	Sample G242	21				
	Sample G246	17				
	Sample G247	16				
	Sample G252	23				
	Sample G270	6				
	Sample G255	5				

Table A-4. Tank 241-AP-105 Analytical Data: Citric Acid

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Organic Complex		mg/L	mg/L	mg/L	mg/L	kg
HPLC.Citric Acid	Sample G239	679	202 to 679	450	182	1,400
	Sample G242	399				
	Sample G246	472				
	Sample G247	608				
	Sample G252	555				
	Sample G270	202				
	Sample G255	233				

Table A-4. Tank 241-AP-105 Analytical Data: Glycolate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Organic Complex		mg/L	mg/L	mg/L	mg/L	kg
LC.Glycolate	Sample G239	800	500 to 800	607	102	1,890
	Sample G242	650				
	Sample G246	600				
	Sample G247	600				
	Sample G252	600				
	Sample G270	500				
	Sample G255	500				

Table A-4. Tank 241-AP-105 Analytical Data: Oxalate

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Deviation (Sample)	Projected Inventory
Organic Complex		mg/L	mg/L	mg/L	mg/L	kg
LC.Oxalate	Sample G239	400	200 to 1,200	521	376	1,620
	Sample G242	350				
	Sample G246	300				
	Sample G247	200				
	Sample G252	300				
	Sample G270	900				
	Sample G255	1,200				

Table A-5. Tank 241-AP-105 Analytical Data: Specific Gravity

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Physical Property						
DM.SpG	Sample G409	1.298	1.298 to 1.389	1.333	0.00788	
	Sample G407	1.338				
	Sample G402	1.338				
	Sample G401	1.389				
	Sample G418	1.300				
	Sample G417	1.327				
	Sample G413	1.335				
	Sample G412	1.377				
	Sample G396	1.298				
	Sample G397	1.300				
	Sample G392	1.341				
	Sample G391	1.344				
	Sample G422	1.348				
	Composite Sample G378	1.334				
	Composite Sample G379	1.329				

Table A-5. Tank 241-AP-105 Analytical Data: Percent Water

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Evaluated Data Result	Standard Error	Projected Inventory
Physical Property		%	%	%	%	
TGA.% H_2O	Sample G409	64.5	55.1 to 64.6	60.3	0.847	
	Sample G407	60.3				
	Sample G402	60.1				
	Sample G401	55.1				
	Sample G418	64.3				
	Sample G417	61.3				
	Sample G413	60.1				
	Sample G412	55.4				
	Sample G396	64.6				
	Sample G397	63.6				
	Sample G392	60.1				
	Sample G391	59.5				
	Sample G422	59.3				
	Composite Sample G378	60.2				
	Composite Sample G379	60.2				

Table A-5. Tank 241-AP-105 Analytical Data: Total Inorganic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Physical Property		µg/mL	µg/mL	µg/mL	µg/mL	kg
COUL.TIC	Sample G409	6,040	3,480 to 6,180	4,490	298	14,000
	Sample G407	3,700				
	Sample G402	3,850				
	Sample G401	3,480				
	Sample G418	6,180				
	Sample G417	3,820				
	Sample G413	3,880				
	Sample G412	3,600				
	Sample G396	5,705				
	Sample G397	6,160				
	Sample G392	4,860				
	Sample G391	4,710				
	Sample G422	3,870				

Table A-5. Tank 241-AP-105 Analytical Data: Total Organic Carbon

Analyte	Laboratory Sample Identification	Analytical Data Result	Range of Values	Statistical Mean	Standard Error	Projected Inventory
Physical Property		µg/mL	µg/mL	µg/mL	µg/mL	kg
COUL. TOC	Sample G409	2,770	2,260 to 3,240	2,750	79.6	8,550
	Sample G407	2,850				
	Sample G402	3,010				
	Sample G401	3,240				
	Sample G418	2,990				
	Sample G417	2,620				
	Sample G413	2,530				
	Sample G412	2,320				
	Sample G396	2,720				
	Sample G397	2,870				
	Sample G392	2,260				
	Sample G391	2,830				
	Sample G422	2,800				
	Composite Sample G378	2,770				
	Composite Sample G379	3,030				

Table A-6. Tank 241-AP-105 Analytical Data: Volatile Organics

Analyte	Result (µg/L)	Analyte	Result (µg/L)
Chloromethane	ND	Trichloroethane	ND
Bromomethane	ND	Dibromochloromethane	ND
Vinyl Chloride	ND	1,1,2-Trichloroethane	ND
Chloroethane	ND	Benzene	ND
Methylene Chloride	ND	trans-1,3-Dichloropropene	ND
Acetone	550	Bromoform	ND
Carbon Disulfide	ND	4-Methyl-2-Pentanone	ND
1,1-Dichloroethene	ND	2-Hexanone	ND
1,1-Dichloroethane	ND	Tetrachloroethene	ND
trans-1,2-Dichloroethene	ND	1,1,2,2-Tetrachloroethane	ND
cis-1,2-Dichloroethene	ND	Toluene	ND
Chloroform	ND	Chlorobenzene	ND
1,2-Dichloroethane	ND	Ethylbenzene	ND
2-Butanone	ND	Styrene	ND
1,1,1-Trichloroethane	ND	m&p-Xylene	ND
Carbon Tetrachloride	ND	Isopropylbenzene	ND
Vinyl Acetate	ND	1,3,5-Trimethylbenzene	ND
Bromodichloromethane	ND	1,2,4-Trimethylbenzene	ND
1,2-Dichloropropane	ND	1,2,3-Trimethylbenzene	ND
cis-1,3-Dichloropropene	ND		

Table A-7. Tank 241-AP-105 Analytical Data: Semivolatile Organic

Analyte	Result	Analyte	Result
1-Butanol	ND	2,6-Dinitrotoluene	ND
Pyridine	ND	3-Nitroaniline	ND
Phenol	ND	Acenaphthene	ND
bis(2-Chloroethyl)ether	ND	2,4-Dinitrophenol	ND
2-Chlorophenol	ND	4-Nitrophenol	ND
1,3-Dichlorobenzene	ND	Dibenzofuran	ND
1,4-Dichlorobenzene	ND	2,4-Dinitrotoluene	ND
Benzyl alcohol	ND	Diethylphthalate	ND
1,2-Dichlorobenzene	ND	4-Chlorophenyl-phenylether	ND
2-Methylphenol	ND	Fluorene	ND
bis(2-Chloroisopropyl)ether	ND	4-Nitroaniline	ND
4-Methylphenol	ND	4,6-Dinitro-2-methylphenol	ND
N-Nitroso-di-n-propylamine	ND	N-Nitrosodiphenylamine (1)	ND
Hexachloroethane	ND	Tributylphosphate	ND
Nitrobenzene	ND	4-Bromophenyl-phenylether	ND
Isophorone	ND	Hexachlorobenzene	ND
2-Nitrophenol	ND	Pentachlorophenol	ND
2,4-Dimethylphenol	ND	Phenanthrene	ND
Benzoic acid	ND	Anthracene	ND
bis(2-Chloroethoxy)methane	ND	Di-n-butylphthalate	ND
2,4-Dichlorophenol	ND	Fluoranthene	ND
1,2,4-Trichlorobenzene	ND	Pyrene	ND
Naphthalene	ND	Butylbenzylphthalate	ND
4-Chloroaniline	ND	3,3'-Dichlorobenzidine	ND
Hexachlorobutadiene	ND	Benzo(a)anthracene	ND
4-Chloro-3-methylphenol	ND	Chrysene	ND
2-Methylnaphthalene	ND	bis-(2-Ethylexyl)phthalate	ND
Hexachlorocyclopentadiene	ND	Di-n-octylphthalate	ND
2,4,6-Trichlorophenol	ND	Benzo(b)fluoranthene	ND
2,4,5-Trichlorophenol	ND	Benzo(k)fluoranthene	ND
2-Chloronaphthalene	ND	Benzo(a)pyrene	ND
2-Nitroaniline	ND	Indeno(1,2,3-cd)pyrene	ND
Dimethylphthalate	ND	Dibenz(a,h)anthracene	ND
Acenaphthalate	ND	Benzo(g,h,i)perylene	ND

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